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TISSUE FLUID

Our usual conception has been to consider what we ordinarily term the lymph as fundamentally concerned in relation to the tissue spaces of the body. The colorless fluid of the tissues was called lymph long before the lymphatics were discovered, and it was therefore natural that the name should apply when the vessels containing this fluid were discovered.

Tissue fluid should be differentiated from tissue juice. The latter term refers to the fluid which may be pressed out of the tissue, as for example, the muscle or gland juice, each of which may vary in certain of its characteristics. The tissue fluid is the fluid which is present in the tissue spaces of the living animal, and includes the fluid of the serous cavities, the cerebro-spinal fluid and the aqueous humor.

It has been known for years that the plasma of the blood is constantly exuded from the blood capillaries into the tissue spaces, so that the cells of the supporting tissues and the special cells of each organ are bathed in fluid. With the varying activity of the cells, the fluid becomes laden with nutritive and stimulative substances and waste products so that its composition varies wide-

ly. In addition to these primary small spaces always containing fluid, there are also special systems of large spaces arising from small spaces by a definite method containing a fluid different from the other fluids in the body, as for example, the subarachnoid spaces which surround the central nervous system. It is now known that the cerebro-spinal fluid is secreted by a special organ and contains certain products of internal secretion. The pia-arachnoid membrane has an interesting structure and development. The arachnoidal villi are lacelike projections of the arachnoid into the dura, lying along the dural veins and lead to the dural sinuses. These villi have been shown to be the main organs of absorption for the cerebro-spinal fluid and are covered with a layer of mesothelial cells which tend to become more abundant at the tips, forming cell nests. Other relatively large systems of spaces are in the internal ear and in the eye.

Experiments have shown that the central nervous system has a special system of tissue spaces beginning with the spaces surrounding every individual nerve cell of the brain extending into the subarachnoid area and are drained, not by lymphatics, but by the arachnoidal villi into the cerebral sinuses. A similar system of absorbents, the pectinate villi, leading to the canal of Schlemm has been shown for the anterior chamber of the eye. When injections are made into the peritoneal cavity the results vary widely. Although our knowledge is far from complete, it has been shown that certain true solutions are absorbed by the blood vessels. On the other hand, it is known that granules are in large part taken up by special large phagocytic cells some of which pass into the lymphatics of the diaphragm. This suggests a partial differentiation in absorption between blood vessels and lymphatics. A partial differentiation of function of this character is a familiar phenomenon in the intestinal villi where most of the fat passes into the central lacteal while the carbohydrates pass directly into the blood stream. Investigations have shown that the blood vessels are the primary absorbents, and that subsequently partial systems of absorbents develop, such as the arachnoidal villi and the lymphatics which drain into the veins.

The foregoing statements are based largely on an article on "The Method of Growth of the Lymphatic System" by Florence R. Sabin, in a recent number of *Science*. Much discussion has centered around the lymphatics as to whether they represent an

open or closed system. The older view is that they are an open system and that the lymphatics began in wide mouths in the walls of the various cavities of the body, but these openings proved difficult to find. In the newer view of the lymphatics as a closed system, the lymphatic capillaries are regarded as definite vessels completely lined by endothelium and related to the tissue spaces just as blood capillaries are.

The study of the conditions in the adult system seems to be inadequate for a solution of the question. Embryology or the study of the development of the structures offers more promise, and Miss Sabin has adduced some interesting facts bearing upon the lymphatics as a closed system.

The lymphatic system begins in the human embryo during the sixth week of development. The first lymphatics are blunt buds which come from the internal jugular veins at the root of the neck. They are filled with blood which backs into them from the vein. These buds soon establish connection with each other and form a plexus which develops into a large sac. From this sac lymphatics grow out to the skin of the head and neck, to the thorax and arm and partially invade the deep structures of the head. The sac itself is transformed into different groups of lymph glands which might be analyzed as the primary lymph glands of the neck and these bear a definite relation to the secondary glands which form along the ducts growing out from the sac. Later stages show the development of lymphatic buds from some of the abdominal veins. The main abdominal lymphatics begin as a retroperitoneal sac which develops from a vein connecting the two Wolffian bodies. This sac is the key for the study of the abdominal lymphatics. The retroperitoneal sac and the paired iliac sacs become connected with the left jugular sac by means of the thoracic duct. There is thus formed a primary lymphatic system of sacs connected by the thoracic duct. In a general way lymphatic vessels from the jugular sacs grow to the head, thorax and thoracic viscera; those from the retroperitoneal sac to the abdominal viscera and in part to the thoracic viscera; and those from the iliac sacs to the abdominal walls and legs. The view held by Miss Sabin, based largely upon embryological evidence, is that the lymphatics arise from the endothelium of the veins and grow by the multiplication of endothelial cells, as opposed to the theory that the lymphatics arise from tissue spaces and grow by adding on more tissue spaces.

Up to the sixth week in the human embryo, the only absorbents are the veins. Subsequently other systems develop, as the lymphatic vessels and arachnoidal villi to assist in the function of absorption. Ta facilitate clearness the term "plasma" should be restricted to the fluid within the blood vessels, "lymph" to the fluid within the lymphatics and "tissue fluid" to the fluid within the tissue spaces. P. A. F.

THE POISONING OF STOCK BY LARKSPUR

The U. S. Department of Agriculture has found that, with the exception of loco poisoning, larkspur poisoning is the greatest cause of loss in western cattle herds. Losses, it is said, are reported from all the mountain regions between Mexico and Canada and from the Rocky Mountains on the East to the coast on the West.

Experiments indicate that the various species of larkspurs are poisonous to cattle and horses, but not to sheep. Except under unusual circumstances it was found that horses do not eat enough of the plant to produce any ill effect. From a practical standpoint it may be said that larkspur affects cattle only. It was found that a quantity of the weed equal to at least 3 per cent of the weight of the animal was necessary to produce poisoning.

The fact that sheep can apparently feed upon larkspur with impunity, may be utilized to protect the cattle. The larkspur infested range may be used for sheep rather than cattle; or the grazing on these areas may be arranged in such a way that the larkspur shall be first eaten down by the sheep.

Generally speaking, there are two groups of larkspur—the tall and the low. The low disappear from the range early in July and cases of poisoning from them are usually confined to the months of May and June. The tall larkspurs live through the summer season, making their appearance in the early spring. This is the time in which they are most poisonous. After blossoming, their poisonous character appears to diminish. Ultimately it disappears and the plant dries up, although the seeds remain poisonous. In Colorado most of the cases of poisoning from the tall larkspur occur in May and June, with sporadic cases in July. In other localities where blossoming occurs later, poisoning may take place as late as August or even September.

The first evidence that the animal has been poisoned is frequently shown by falling down. After a short interval it will

probably regain its feet only to fall again. As the effect of the poison wears off, the animal is able to keep on its feet for longer and longer periods and finally walks off very much as if nothing had happened. In severer cases it is unable to regain its feet and dies.

Experiments indicate that beneficial results may be obtained by treating the poisoned animals with hypodermic injections of physostigmin salicylate, pilocarpin hydrochloride, and strychnin sulphate. If necessary these treatments may be supplemented by hypodermic injections of whiskey. P. A. F.

EUROPEAN CHRONICLES

Bois Jerome.

THE DEFENSE OF THE ORGANISM BY PHAGOCYTES. — Several months ago there was presented at one of the great scientific meetings of the Institute in Paris a long communication by Professor Dastre of the Academie des Sciences, on a subject of intense interest, viz: "Wounds of the Battlefields and the Natural Reacting Organism," and Professor Kaufmann of Alfort has published in the *Recueil* a lengthy review of the original and considered at large the five chapters it contained.

Chapter I refers to the danger of wounds of the battlefields and their infection by microbes. The second treats of the defense of the organism by the phagocytes. The third examines the defense by the humors (bacteriolysins, antitoxins, vaccines, immunization, sero-therapy, antigens.) Chapter 4 treats of the mechanism of the immunizing action (hemolysis, alexin, sensitization, deviation of the complement,) etc. The last, chapter 5, relates to the treatment of wounds of the battlefields.

All these chapters are treated in a masterly way and I regret that their length does not permit me to consider them as they deserve.

Chapter 2, however, has appeared to me as the one that would interest our readers most, for the practical information it gives and on that account, I extract it from Kaufmann's review.

PHAGOCYTES OR DEVOURING CELLS are cells which possess the faculty of moving and adhering to solid objects, to envelop them and if these are sufficiently small to swallow them and finally digest them and promote their disappearance. If it happens that the digestion cannot take place, they carry in themselves, to the

intestinal mucous membranes, whatever they have eaten, deposit it or are disorganized and disappear.

The principal phagocytes are the white blood corpuscles, the *leucocytes*. By their movement they can pass out of the blood vessels and spread in the surrounding tissues, where there are microbes more or less infectious, and attract them. This attraction, which takes place in the inflamed tissues, filled with blood and distended, is due to a chemical substance, produced by the microbe spreading in the environment, acts on the leucocyte, calls it, so to speak, out of the vessel and guides it towards its prey. The outward motion of the leucocytes from the inflamed blood vessels (diapedesis) takes place without escape of blood. The white corpuscle does not cut through the vascular walls, it slips between its elements and travels through the interstices and guided by *chemiotropism* goes towards the invading microbian enemy. For the defense of the organism, legions of leucocytes are ready. They pass to the spot and invade the region contaminated by the microbes.

In the wound, covered with serous exudation, the battle is fought between the microbes and the phagocytes. Ordinarily, the latter pass to the bacteria, envelop and swallow them and surround them with their dissolving secretions, digest and absorb them. In ordinary conditions, the leucocytes treat in this manner all foreign particles that are within their reach, when they are sufficiently small or non-resistant to envelopment. If the foreign body is too voluminous to be the prey of only one leucocyte, others come, they associate and attach themselves to its surface, dilute it and finally overcome it. In this way, the minute objects which are accidentally introduced in the fortress of the organism, are treated.

The phagocytes destroy their enemies and use them for food.

The number of phagocytes taking part in this fight, must be considerable. Each cubic millimeter of blood contains about 7000: the lymph contains still more and the connective tissue has multitudes. In the phagocyte army, the most active class is the *polynuclears*, the *migrating* cells of the connective tissue form the reserve, and the territorial mobilization, in case of need, is represented by the *fixed cells* of that same connective tissue.

In the battle between the phagocytes and the microbian infection, the victory depends on several factors, namely: the number of fighters, the strength of the army and the various influences which may make the relative force vary.

The strength of the microbes is poison: they have no other. The toxic substance secreted, helps to repulse the phagocytes or to paralyze and destroy them after it has been in contact with or has been swallowed. Indeed all is not finished when the phagocyte has swallowed the microbe. It remains to digest it and that is the essential part of the work. Often, it is not accomplished; it is prevented by some microbian poison, and in this case, relieved from its enemy, the microbe comes out victorious.

The seizure of the microbe and its destruction by digestion are two independent and successive acts, separated, however, by a rather long interval. For instance, the spores of the tetanus bacillus introduced in the body of a guinea pig are rapidly swallowed, but are not killed and are digested but slowly. This operation requires several weeks and during that interval, if the guinea pig is submitted to the action of heat, which has the effect of stimulating the activity of the microbes, these rapidly grow and give rise to fatal tetanus (Vincent.)

The result of the battle between the two adversaries depends on quite a number of circumstances and may take place at all periods of the struggle; sometimes at the beginning, or much later and under different conditions.

When the microbes introduced in a wound are not in too great numbers and have only a moderate virulency, the phagocytes are called by the substances emanated from the microbe, through a kind of gustatory attraction, called positive *chemiotachism*. The phagocytes may swallow the invading microorganisms, but they do not all succeed in digesting them. Some filled with too many or too virulent microbes, carry in themselves a cause for death. Intoxicated by the microbian secretions, they gradually undergo fatty degeneration and become *pus corpuscles*. These are formed especially of dead leucocytes, which have succumbed in the long battle.

In the case of a severe infection, the microbes will have the superiority in number or will secrete a very virulent toxin, able to repell or rapidly intoxicate the phagocytes: then the wound, a true battlefield, is held by the microbes, which develop, and proliferate in it without hindrance. The pus, instead of being creamy, is thin, sanious and not abundant. Infection keeps up, fever persists and the patient succumbs.

In mild cases, the army of leucocytes wins easily. On its side, there are few deaths, a longer persistence permits fatty trans-

formation, that is the formation of yellow pus, but not abundant. The wound granulates and cicatrization goes on.

The body of the microbe is a true factory for poison. These are secretions, called *toxins*. These may be specific, such as those of tetanus and diphtheria, injections of which in the organism have the same effect as the contamination by the microbes themselves. Specific toxins cause the microbian infection without the microbes.

These toxic secretions are the special weapons of the microbe against the subject that attacks it. Among the different varieties found in wounds, some are trivial, and others are specific. There are various diastases, toxins analogous to ferments which have been extracted, for instance, the tetanic bacilli, the streptococci, the staphylococci, and the cholera vibrios. Besides these toxins, poisons thrown out as a true secretion, microbes produce others which may remain firmly incorporated in the microorganism, as occurs in *endodiastases*, such as those of Buchner. Some *endotoxins* are so firmly held that they cannot be liberated except by destruction or dissolution of the microbe.

Therefore microbian infection is resumed in a true intoxication by the specific poison of the microbes.

Phagocytes in their turn fight the microbe with the aid of digestive or destructive secretions. According to Metchnikoff,who has made known the action of phagocytes, the *leucocytic alexin* has for its function the dissolution of the microbe and destruction of its poison.

Finally, in the fight of the phagocytes with the microbes the struggle becomes a kind of *chemical* neutrilization analogous to that of the acids by the alkalines.

The true signification of the defense of the phagocytes closes this interesting chapter. The principle of the protecting action of the phagocytic leucocytes is found in this law of the constitution of the organism, in virtue of which the living individual tends to the conservation of its integrity. The organism does not tolerate foreign substances in its tegumentary envelopes, which separate it from the external world and it always makes all its efforts to repair the disorders promoted by any accidental disturbance.It is the same general principle, which explains the tendency of wounds to cicatrize, a tendency which is always satisfied unless some interference from outside, such as microbian infection, causes an accidental obstacle. All the forces disposed of by the organism work

to the *maintenance and conservation* of its integrity. This principle of the *conservation of the organism* applies not only to the form and structure of the living being, it applies equally to its composition and its vital activity. The result is that form and matter tend equally to maintain, to preserve and to reestablish themselves.

Epizootic Lymphangitis.—Three cases of this affection have been the occasion for M. M. Cazalbou and Pradel, to present a communication which I find in the *Revue de Pathologie Compareé* and from which interesting conclusions are drawn.

In the group of the lymphangites of horses, the clinic has already distinguished several types or species. For instance the diffused reticular lymphangitis, accompanied or free from visible lesions of the white blood cells and following a traumatism whose nature is still not well determined. The ulcerative lymphangitis, due to the bacillus of Preisz-Nocard, the lymphangitis of glanders which does not exist without internal lesions and whose development seems to follow a traumatism in an organism already infected, the sporotrichosis lymphangitis, and finally the epizootic disease which from the point of view of general pathological anatomy, like the ulcerative, that of glanders and the sporotrichosic, presents an ulcerative process of variable severity.

With the exception of the sporotrichosic form the authors have observed all the others since the beginning of the war and the three following are the subjects of their communication:

1st case. At the time of examination, the animal had numerous small abscesses around the eye-lids of the right side and on the corresponding cheek. At the border of the maxillary bone there was a short lymphangitic cord running to the inflamed sub-glossal lymphatic gland. The affection had started in a small lacerated wound, made by a barbed wire fence, over the temporal region. This wound had been received some three weeks before, had cicatrized and then reopened with one or two little abscesses. Therefore the inoculation had taken between three or four weeks to develop.

2nd case. An animal had on the arm, in the direction and along the entire length of the humerus, a big cicatrix, partly indurated and contracting. On a level with the old edges of the cicatrix, there were abscesses, not yet ulcerated, about the size of a

hazel nut. In front of the arm, there was a lymphangitic cord running to a corresponding prescapular adenitis. The initial injury, due to a blow from an automobile had been followed, several weeks after by the first purulent collection.

3rd case. In this subject the disease assumed a classical appearance. From the fetlock, where there was a common contused wound, there started a lymphangitic cord extending to the prepectoral lymphatic gland, with several ulcerated abscesses on its course.

The mallein test, of course, proved negative in the three subjects, which recovered after four or five months treatment.

These observations have brought the authors to the following considerations: 1st. In each one of the affected individuals the primitive inoculation has been received, while the animals were at the front, and during the cold season. As it was not possible to connect the origin of the affection with a previous disease, it is probable that the infectious germ came directly from the external medium into the wounds.

2nd. The parasite of epizootic lymphangitis was first described by Rivolta, as an ellipsoid coccus, with a double enveloping membrane, very apparent, which by its proliferation in lymph, gives rise to the disease in locating itself in the lymphatic vessels of the field injured by the initial traumatism. Considered in the morphology of the sick animal, this cryptococcus has been classed among the ferments. It has also been considered as a protozoan parasite of the white corpuscles and called by some *Leucocytozoon piroplasmoides*. This, however, is not admitted and the study still remains incomplete.

3rd. The various inoculations of the cryptococci of Rivolta which were obtained from the lesions or cultures of the three horses failed to reproduce lymphangitis. In admitting that these vegetable agents are responsible for the development of the disease, it remains certain that the conditions of their multiplication in lymph remains as yet unknown. All that we know is that the cryptococcus is easily transported from one sick individual to a foreign wound.

BIBLIOGRAPHY—REPORT OF THE NEW YORK STATE VETERINARY COLLEGE at Cornell University, for the year 1914-1915.

It is always with new pleasure that I receive this report, which has just arrived, and it is with greater satisfaction that the

occasion is furnished me to allude to it in these chronicles, where I consider, notwithstanding their title of European, I can introduce to my friends across the Atlantic, some material that they possibly have not benefited by.

A report from a public institution might be looked upon as merely a collection, a presentation and a résumé of the entire administration of said institution: a few words of introduction, a reference to the organization, to the faculty, the many professorships and their various duties, to the registration of students, to the arrangement of the curriculum, etc., etc. Of course every one of these subjects is presented in full by Director V. A. Moore, and the presentation is worthy of the leader of that institution and it is completed by concise allusions to other subjects relating to the work done in the various departments, which is treated in a more extensive manner in another part of the report.

As an appendix to the report of Doctor Moore, are presented those of four of the practical departments of the institution.

First, comes the report of cases treated in the consulting and medical clinics by Doctors Udall, Koenig and Wright. The number of animals, 287, is arranged by classes according to the various ailments for which care was demanded.

In the second, that of surgery and obstetrics conducted by Professors W. L. Williams, Frost and Webber, 428 cases cover the list, with 392 horses, 20 cattle, 8 sheep and 8 swine.

The third report is that of the clinics for small animals under the care of Professors H. J. Milks and W. E. Muldoon. This includes 399 dogs, 127 cats, totaling the number of 526 patients.

The report of the ambulatory clinic for large animals is signed by Professors Udall, Koenig, Frost and Webber. At these clinics some 33 students attended and each one had an average number of about thirty trips. The total number of cases visited was 1803.

Following these four reports on practical work, comes what might be called the solid portion of the book presented by Director Moore, viz: a preliminary report on the recognition of Swamp Fever or Infectious Anemia in N. Y. State by Prof. D. H. Udall and C. P. Fitch: an article from Prof. W. L. Williams on Contagious Abortion of Cattle. These two papers are illustrated by a number of plates most valuable to the reader.

Following these Prof. C. P. Fitch has a report on the Conglutination Test with Special Reference to the Diagnosis of Glanders;

from Prof. E. M. Pickens some Instruction in Selecting, Packing and Shipping Specimens for Laboratory Examination; from Prof. H. J. Milks a report on Verminous Bronchitis in Dogs, also illustrated; from Prof. W. E. Muldoon one on Unicinariasis in Dogs and from Prof. S. A. Goldberg one on the Structural Changes that Occur in Certain Specific Inflammations of Joints.

The last few pages of the report are occupied by an important article by Dr. V. A. Moore on the Limitations of Tuberculin in Detecting Tuberculous Infected Animals, another from Prof. Pierre A. Fish on Physiologic Relations—Poultry and finally from Prof. Samuel H. Burnett an article on Lobar Pneumonia, So-called, in Domestic Animals.

In presenting such a complete report to the legislature of the state, the object is evidently to show that all the support given by the state to the institution has been fully appreciated and that no effort has been spared to show that the support was deserved. Similar documents have for years shown the legislature the good work done by the Veterinary College at Cornell University and it is certain that if this last report finds its way among intending students there will be no great difficulty in predicting a large increase in the class and in showing how urgent it is for the legislature to grant Director Moore all the financial help he asks and which is needed to keep up the good work.

L'Abattoir Moderne. (The Modern Abattoir.) This is the second edition of a superior work, for which in 1906, was granted to the author prizes from the Academie de Medicine and from the National Society of Agriculture.

Doctor A. Moreau, late chief veterinary inspector, can be proud of the success obtained by his work, namely, the publication of a large and complete volume treating of all the various subjects connected with abattoirs.

When the first edition was published by the good old firm of Asselin and Houzeau it was my great privilege to call it to the attention of Americans interested in the question and it is a great pleasure for me to do the same again.

This book was written and almost under press when the fearful events of August 1914 threw the world into the terrific struggle which has already cost so many lives. Of course the publication had to be postponed and yet notwithstanding the very extreme

conditions in which it could be executed, today this second edition has come out, revised and considerably enlarged, in the shape of a handsome book that does honor to the editors by its appearance and to its author by the value of its contents and the many plates that illustrate the various descriptions.

This excellent book of nearly 900 pages has its contents divided into four parts.

The first under the title of ABATTOIRS gives a general historical aspect of the subject with a concise consideration of the abattoirs in France and in foreign countries; Germany, Switzerland, Austria, Italy, Spain, etc., in fact of all Europe.

The second treats of the construction of abattoirs. The proper place for such, the general disposition and then the various types of modern French abattoirs.

The third part deals with the interior of the abattoirs, with the disposition and arrangements for killing the various classes of animals, large and small; cattle, sheep, swine, horses. The question of refrigeration and in fact all the various subjects connected with the work carried on at such places.

The fourth part is essentially concerned with the services of the administration of the establishment, and of the sanitary inspection with the many attributes of the veterinarians, the laboratory work, etc., etc.

This concise examination of the contents of the work of Doctor Moreau will scarcely do it the justice it deserves. It is for those who are interested in the subject to fully appreciate its value. The illustrations which are reproduced in detail and the arrangement of the abattoirs of the various countries are of great value and will be consulted and advantageously studied by those to whom the building of an abattoir is a matter of interest.

I regret that illustrations of similar establishments in the United States are not given but hope that a third edition will include the reproduction of the many abattoirs of the large cities of the New World.

RÉSUMÉ OF REVIEWS AND ACKNOWLEDGEMENTS.

JOURNAL OF COMPARATIVE PATHOLOGY AND THERAPEUTICS, (June, 1916).

*Cases of Poisoning in Cattle by Feeding on Meal from Soya Bean after Extraction of the Oil.

Studies in Forage Poisoning.

Thrombosis of Pulmonary Arteries and Necrosis of Extremities in a Bullock.

*The Possibility of Amebic Dysentery in the Dog and its treatment with Emetin.

Osteoma of fowls.

Duplication of the Gall-Bladder in a Sheep.

Johne's Disease—The Reaction of Animals to "Johnin".

RECUEIL DE MEDICINE VETERINAIRE.

*A Case of Aberrant Thyroid Cancer in the Horse.

*A Remarkable Case of Tuberculosis of Castration in a Pig.

*Adynamic Typhosus in American Horses.

BULLETIN DE LA SOC. CENTRALE.

*Treatment of Epizootic Lymphangitis.

*Novarsenobenzol in the Treatment of Epizootic Lymphangitis.

CHICAGO VETERINARY BULLETIN (March).

Obituary of Doctor Arthur Hughes.

CORNELL VETERINARIAN.—Lead Poisoning in Calves—Roup or Chicken Pox—Contagious Pleuro Pneumonia in Horses.

CIRCULAR No. 58, Department of Agriculture.—Reports upon the Federal Meat Inspection.

A. LIAUTARD.

Articles marked (*) will be analyzed in other chronicles.

Dr. Clifford Ackley, veterinary inspector in the Bureau of Animal Industry, stationed at Blaine, Washington, has resigned. He has purchased the plant and business of a weekly newspaper at Winlock, Washington, and intends to take up the management of this business, together with the practice of veterinary medicine.

Dr. Maurice C. Hall, a graduate in veterinary medicine from George Washington University, occupying the position of assistant zoologist in the Bureau of Animal Industry, has resigned to take a position with Parke, Davis & Co., of Detroit, Michigan, as a parasitologist. He will conduct original investigations in the treatment of animals for parasites.

THE BULL AS A DISSEMINATOR OF CONTAGIOUS ABORTION*

F. B. HADLEY AND H. LOTHE, Madison, Wis.

INTRODUCTION. A large number of livestock men hold that the bull is an important factor in the dissemination of contagious abortion in the herd. A smaller number believe that the bull acts merely as a passive carrier of the abortion disease and is not actively concerned in its transmission.

These conflicting hypotheses have led to confusion on the part of all parties interested in the control of bovine abortion. It was impossible to prove or disprove either assumption until the exact cause of contagious abortion was discovered by Bang. Now that the causative organism has been isolated and methods of diagnosis perfected[1], means are at hand to control accurately and to interpret correctly the results of experiments.

This paper records the results of an experiment that was designed to shed light upon the question as to the ability of both mechanically infected and systemically infected bulls to transmit abortion by cohabitation. The work was made possible by a special appropriation of $5,000.00, granted by the Wisconsin Legislature of 1912 to the College of Agriculture of the University of Wisconsin.

EXPERIMENTAL OBSERVATIONS. Before describing our experimental work it seems desirable to review briefly the work of a related nature recorded in the available literature.

The first reference to the part played by the bull in the transmission of contagious abortion appears in an article by Bang[2]. Later investigations led him[3] to conclude that cattle are often infected through the mouth and that the bull is not always to blame.

M'Fadyean and Stockman[4] attempted to infect cows by using

*Published by Permission of the Director of the Agricultural Experiment Station, University of Wisconsin.
Presented at the meeting of the A.V.M.A., Detroit, Mich, Aug. 22, 1916.

(1) Hadley, F. B. and Beach, B. A. The Diagnosis of Contagious Abortion in Cattle. *Research Bul. 24, Wis. Agr. Exp. Sta.*, 1912.
(2) Bang, B. Die Aetiologie des seuchenhaften (infectiösen) Verwerfens. *Zeit. für Tier., Band.* 1, S. 241, 1897.
(3) Bang, B. Das seuchenhafte Verwerfen der Rinder. *Arch. f. wiss. u. prak. tier., Band.* 33, *S.* 312, 1907.
(4) *Report of the English Commission on Epizootic Abortion, Appendix to Part I*, p. 17, 1909.

a soiled bull for service, but admit that their experimental conditions did not approximate to those found in general practice. It should be noted, however, that in no case did they find lesions of the abortion disease in the uteri of their experimental cows, neither were they able to demonstrate the presence of abortion bacilli, although careful microscopic and cultural examinations were made from the uterine mucous membrane, cotyledons, and the contents of the fetal stomach. Only one heifer was allowed to live until the normal period of gestation was completed and she never showed signs of aborting and gave birth to a strong, healthy calf at full term.

This and other experiments conducted by the above mentioned investigators led them to assert that the bull has no part in the dissemination of contagious abortion, or, if he has a part, it is merely that of a passive carrier.

Cotton[5] found it impossible to demonstrate the presence of abortion bacilli in the reproductive organs of a bull that had been used to serve aborting cows, or in the testicles of two bull calves, one of which had been fed and the other injected with cultures of the abortion bacillus. He states that his investigations seem to indicate that the bull does not harbor the organisms in the testicles.

In a personal communication Dr. E. C. Schroeder of the Bureau of Animal Industry, United States Department of Agriculture, states that he has found that bulls which are regularly exposed to abortion-infected cows rarely react with the agglutination test, notwithstanding that bulls which have received inoculations of abortion bacilli invariably react with this test. But, though he and his coworkers have made careful and extensive bacteriologic examinations of bulls after such inoculations, they have not been able to determine whether the abortion bacillus has the faculty of persisting anywhere in the bull's body, or of causing discoverable lesions in it.

While many investigators have carried out experiments with cows to determine how abortion infection is acquired and what lesions are produced, little work has been done along these lines with the bull. That this animal may sometimes be inoculated suc-

(5) Cotton, W. E. *Proceedings of the American Veterinary Medical Association*, p. 851, 1913.

cessfully has been shown by M'Fadyean, Sheather and Minett[6] in their experiment in which cultures of the abortion organisms were introduced into the prepuce.

It is interesting to note that the data relative to the reaction to the serum tests by the bull, gathered by investigators in Europe, correspond closely with that gathered by laboratory workers in the United States.

Attention was called in a previous paper from our laboratory[7] to the fact that not more that 25 per cent of the bulls in herds where abortion was known to exist produce specific antibodies indicative of infection in their blood serum. On the other hand, about 36 per cent of the cows in such herds contain these antibodies as shown by the serum tests for abortion. As these figures are based on data secured from tests on 5,000 head of cattle over a period of four years, they cover a sufficiently large number of animals to be reliable.

Schroeder[8] states that it seems that the abortion bacilli rarely get into the bodies of male cattle in a way to cause modifications which can be determined by any means at our command. He adds, however, that bulls may play a very important part in the transference of these organisms from cow to cow.

Since it has been shown by Melvin[9] that infected cows may eliminate virulent abortion organisms in their milk and vaginal secretions, the natural inference is that infected bulls may do so in their seminal or preputial secretions.

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(6) M'Fadyean, Sheather and Minett. Researches Regarding Epizootic Abortion of Cattle. *Jour. of Comp. Path and Thera.* Vol. XXVI, p. 142, 1913.

(7) Hadley, F. B. and Beach, B. A. Results with Complement Fixation Test in the Diagnosis of Contagious Abortion in Cattle. *Proc. of the A.V.M.A.*, p. 356, 1912.

(8) Schroeder, E. C. The Cause and Occurrence of Contagious Abortion in Cattle. *Jour. of the Am. Vt. Med. Assoc.*, Vol. XLVIII, p. 304, 1915.

(9) Melvin, A. D. The Bacterium of Contagious Abortion of Cattle Demonstrated to Occur in Milk. *U. S. Dept. of Agr., Bureau of Animal Industry, Cir.* 198, 1912.

Foot note:—Although it is assumed in this paper that a reaction to the complement fixation or agglutination test means a systemic infection, the junior author thinks that it may be possible for the infecting organisms to be injected by the bull and call forth the production of antibodies in the blood stream without a systemic infection. As it has been impossible to prove or disprove this conception the senior author feels that it is justifiable to interpret a typical reaction as indicative of a systemic infection.

Williams[10] maintains that once a bull reacts to the agglutination and complement fixation tests we have no evidence to show that the infection is ever eliminated from the animal's body. He contends that such a bull conceivably must be capable of transmitting the infection by cohabitation, but has carried out no experiments of a scientific nature to sustain his contention. That he is in doubt is evident by the following statement: "Conclusive evidence that abortion bacilli can be readily transmitted by cohabitation and that it will rapidly induce abortion in pregnant animals is wanting."

PRACTICAL OBSERVATIONS. Apparently the abortion disease may be introduced in a previously healthy herd by the bull, if we accept the testimony of practical breeders. Some of these men claim that the only cows to abort during the first part of an epizootic are those served by bulls used for infected cows, while other cows in the herd will carry their calves to maturity, but abort during the following gestation period. This evidence is purely circumstantial so has only limited scientific value. If it could be proved that the infection was contracted from the contaminated bull and no place else, the chain of evidence would be complete and the bull would be incriminated. Unfortunately this has not been possible.

There are, on the other hand, breeders whose experience has led them to believe that the bull is incapable of transmitting the abortion infection from cow to cow either by copulation or otherwise. In fact, they assert that the same bull may be used for service in two herds and yet cows in but one of the herds will abort.

We have in mind the case of a farmer who purchased some pure bred cows and a bull at a public sale. These cattle were placed in his home herd where the abortion disease had never existed. Shortly the newly purchased cows commenced to abort. Later cows in his original herd started to abort until the infection had become quite generally distributed. This man also maintained a herd of grade cows on another farm a short distance away. The same bull was used in both herds, as well as on neighbors' cows. None of these cows aborted, although the disease continued its havoc in the pure bred herd. It should be noted that this bull gave a positive reaction to the complement fixation test for abor-

(10) Williams, W. L. The Outlook for the Control of Cattle Abortion. *Jour. of the Am. Vet. Med. Assoc., New Series,* V. II, p. 199, 1916.

tion, and so may be considered to have had a systemic infection, as well as having had every opportunity to act as a mechanical transmitter.

Additional light is thrown on the question of the influence of the bull in causing abortion by a careful herd record that was kept in a large dairy over a period of three years. During this time 1,238 conceptions resulted from service by 29 different bulls. There were dropped 1,043 full time calves, while 195 fetuses were aborted. That is, 84 per cent of the cows carried their calves to maturity, while 16 per cent of them aborted.

As would be expected in the light of our present knowledge of abortion, it was impossible to incriminate one bull more than another for no correlation could be established between the number of abortions and the different bulls. It was found that heifers aborted much oftener than older cows.

The cows that had aborted were bred almost without exception to one or the other of two bulls reserved for them. At the same time these bulls were used on virgin heifers. It is interesting to note that about 45 per cent of these heifers aborted. This would point to the bull as a very important factor in the transmission of the abortion disease, but for the fact that a similar percentage of abortions occurred in other heifers that were served by another bull that was used almost exclusively on heifers that had never aborted.

A careful consideration of these experimental and practical observations makes it apparent that our exact knowledge of the bull as a factor in the dissemination of cattle abortion is meager, to say the least.

PLAN OF THE EXPERIMENT. In order to shed more light on this highly important veterinary problem, the experiment to be described was carried out.

The plan of procedure was to mate abortion-infected bulls with virgin, abortion-free heifers. This involved the procurement of animals that would meet these requirements. In the first place, it was necessary to find bulls that had been used for service in infected herds and had themselves become infected; secondly, virgin heifers that were free from abortion infection and had never been exposed to the disease.

It should be stated that the agglutination and complement fixation tests were relied upon as guides in the selection of these

animals. Together with the clinical data these tests were also used to interpret the results of the experiment. More reliance was placed in the fixation than the agglutination test for the reason that in our experience it has shown itself to be in closer harmony with clinical data. In our opinion both these tests have fully justified our faith in them, certainly insofar as the heifers are concerned, for none of them aborted or showed other signs of infection during the first gestation period. The chance of error in technique and interpretation of the serum tests on the experimental cattle was eliminated by including serum samples of cattle from other herds, whenever tests were made.

An animal has been considered infected when it reacted to one or both of these tests. It is evident that the phenomenon of abortion itself could not be used to determine infection because the cow does not always abort as a result of infection and because the bull cannot be measured by it.

In handling the heifers every precaution was taken throughout the entire course of the experiment to exclude all possible sources of infection except the bulls. The animals were pastured by themselves until late fall, when they were allowed the run of a new, closed shed in which cattle had never been kept. During the winter they were turned into the barnyard for daily exercise.

Originally there was no thought of carrying the heifers much beyond their first parturition period. With the development of the work it became evident that much valuable information could be gathered by continuing to observe some of the heifers for a longer period. As soon as this became apparent, arrangements were made to transfer them to a herd of cattle that were on restricted rations. We hesitated before making the transfer as the rations were of such a nature as to cause abortion and because several of the cows in this herd were infected with abortion. It was thought that the latter would act as sources of infection that could not be controlled. However, it was decided to take these risks. Subsequent developments have shown that this was a fortuitious arrangement, as it gave an opportunity to follow these heifers through a second gestation period in an environment quite different from that of their first period. This explains why the data on bulls 3, 4, and 5 is meager.

Histories of the Animals. Summaries of the service records and parturition and abortion test records of the fifteen ani-

TABLE I. SERVICE RECORDS OF EXPERIMENTAL ANIMALS

Heifer	Bull	Date	Bull	Date	Bull	Date	Bull	Date	Bull	Date	Bull	Date	Bull	Date
127	1	8-14-14												
129	2	10-10-14												
443	1	9-15-14	2	10-6-14	2	10-28-14	3	10-4-15	3	10-25-15	3	12-2-15	3	12-24-15
439	2	10-14-14	2	11-5-14	3	11-18-15	4	1-7-16	5	1-27-16				
364	1	8-14-14	2	9-4-14	2	11-28-14	3	12-20-15						
131	2	12-5-14	2	12-26-14	3	11-24-15	3	12-14-15	4	1-4-16				
257	2	12-16-14	2	1-6-15	4	1-7-16	5	1-29-16	5	2-18-16				
128	2	12-13-14	2	1-3-15	2	1-24-15	3	10-30-15	3	11-19-15	3	12-22-15	4	1-8-16
130	2	12-?-14	2	2-?-15	2	3-?-15	2	4-27-15						
440	2	1-?-15	2	3-?-15	2	4-?-15	2	7-?-15	5	2-?-16	5	3-31-16	5	4-17-16

mals used in this experiment are given in Tables I and II. The individual history of each follows:

BULL 1. A pure bred, registered Guernsey that had been used for service for two years for cows that had aborted and were eliminating virulent abortion bacilli in their secretions and excretions. He first reacted to the complement fixation test in January, 1912. Later his blood serum was tested for abortion agglutinins and found to contain them, but this was nearly a year after cows which he had served reacted and aborted. There is no reasonable doubt but that he had a systemic infection.

It was the original plan to breed all the heifers to this bull but on account of his slowness and heavy weight it was found necessary to replace him as head of the herd with a younger bull. This was not done, however, until he had served heifers 127, 443, and 364. The former was the only one of these to conceive to his service.

BULL 2. Also a pure bred Guernsey that was purchased October 1, 1914 from a herd in which the abortion disease was very prevalent, 80 per cent having responded to the abortion tests. The owner considered him a good sire but wished to dispose of him because he believed him directly responsible for the large number of abortions in the herd. This was due to the fact that the first five cows he ever served aborted, as did many of those served later. The last cow known to be infected was served by this bull August 9, 1914.

The first experimental heifer to be bred by this bull was 443, on October 6, 1914. She failed to conceive at this service but did on October 28. Heifer 129 was served October 10, 1914 and settled at this service. The other heifers were bred subsequently but most of them required more than one service before conception took place. So far as the experiment went, the greater number of services was desirable because they afforded a better opportunity for the heifers to become infected by the bull. Furthermore, these repeated copulations provided conditions by which any venereal infection would have been greatly increased in virulence, if the experience gained in the study of other venereal diseases can be applied to contagious abortion. This is brought out by Williams[11] as follows: "If a bull has acquired in a moderate degree

(11) Williams, W. L. Researches Upon Contagious Abortion of Cattle. *Report of the N. Y. State Veterinary College*, 1914-15.

TABLE II. PREGNANCY AND ABORTION T

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Name or number	Sex	Date of first conception	Date due to calve	Date of calving	c. a. 5-12-14	c. a. 7-30-14	c. a. 10-21-14	c. a. 11-24-14	c. a. 1-9-15	c. a. 2-16-15	c. a. 3-23-15	c. a. 4-28-15	c. a. 5-25-15	c. a. 7-8-15
1	Male				+ +	+								
2	Male				+		+ —	+ —	+ —	+ —	+ —	+ —	+ —	—
3	Male													
4	Male													
5	Male													
127	Female	8-14-14	5-26-15	5-23-15	—	—	— —	— —	— —	— —	— —	— —	— —	
129	Female	10-10-14	7-22-15	7-20-15	—	—	— —	— —	— —	— —	— —	— —	— —	—
433	Female	10-28-14	8-9-15	8-7-15	—	—	— —	— —	— —	— —	— —	— —	— —	—
439	Female	11-5-14	8-17-15	8-17-15	—	—	— —	— —	— —	— —	— —	— —	— —	—
364	Female	11-28-14	9-9-15	9-3-15	—	—	— —	— —	— —	— —	— —	— —	— —	—
131	Female	12-26-14	10-7-15	10-6-15	—	—	— —	— —	— —	— —	— —	— —	— —	—
257	Female	1-6-15	10-18-15	10-19-15	—	—	— —	— —	— —	— —	— —	— —	— —	—
128	Female	1-24-15	11-5-15	11-3-15	—	—	— —	— —	— —	— —	— —	— —	— —	—
130	Female	4-27-15	2-16-16	1-28-16	—	—	— —	— —	— —	— —	— —	— —	— —	—
440	Female	4-17-16	1-23-17		—	—	— —	— —	— —	— —	— —	— —	— —	—

TION TEST RECORDS OF EXPERIMENTAL ANIMALS

Complement Fixation and Agglutination Tests for Abortion

c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.	c. a.
	7-8-15	8-2-15	9-17-15	10-15-15	11-6-15	12-1-15	1-4-16	2-25-16	3-8-16	3-17-16	4-5-16	4-13-16	5-12-16	6-2-16	6-28-16	7-13-16	8-14-16
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—	— —	— —	— —	— —		— —	— —	— —	— ?	— +	+ +	+ +	+ +	+ +	+ +		+ +	+ +
—	— —	— —	— —	— —		— —	— —	— —		— —		— —	— —	— —	— —		— —	
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—	— —	— —	— —	— —		— —		+ ?	+ ?									
—	— —	— —	— —	— —	— —	— —	— —	— —	? —	? +	+ +							
—	— —	— —	— —	— —	— —	— —	— —											
—	— —	— —	— —	— —	— —	— —	— —		— —	— —		— —	— —	— —		— —	

the infection of contagious abortion, but not sufficient to constitute any serious menace to his breeding power, the infection may be enormously stimulated and its power for evil indefinitely multiplied by repeated copulation."

It would, therefore, seem that conditions were ideal for this bull to infect the heifers if his genitalia were contaminated with or he was giving off living, even if only avirulent, abortion bacilli in his secretions. However, none of the eight heifers that conceived to his service aborted.

BULL 3. This bull and bulls 4 and 5 were employed only during the second year of the experiment. He is a pure bred Holstein and has neither never served an infected cow nor given a reaction to the abortion tests. He was bred to 128 in October, November, and December1915; to 443 twice in October and twice in December, 1915; to 439, 131, and 364 in November and December, 1915 (see Tables I and II). Although heifers 128 and 433 later became reactors, there is no direct evidence that this bull infected them. In view of the facts that the other heifers served by him remained normal and that he never has given a reaction to either the complement fixation or the agglutination tests, it is more reasonable to attribute the infection of these heifers to other sources than to the genitalia of this bull.

BULL 4. A pure bred Angus that had served a cow in November and December, 1915 which had aborted some months previously and was a reactor. Tests failed to show that he was systemically infected. In order to discover whether he could transmit the abortion disease after having served infected cows, he was bred to heifers 439, 131, 257,and 128 during the month of January, 1916. Reference to the histories of these animals will show that the latter two reacted about a month later and were slaughtered, but no lesions or bacilli of abortion could be found. He served heifer 439 once, but to no effect. The fact that heifer 131 aborted 172 days after service by this bull is important and points to him as the source of infection. However, other factors were operative in the case of this heifer as reference to the history will show. In view of the fact that he has never reacted to the abortion tests, there is evidence that he may not be to blame.

BULL 5. An Angus-Jersey cross bred that was never used for service on abortion-infected cows and never gave a reaction to the abortion tests. He was mated to heifers 439, 257, and 430. Of

these 257 later became a reactor but as she was served by bulls 2 and 4 a short time before, there is a much greater probability that they or the infected cows with which she was in contact infected her than this bull.

HEIFER 127. This heifer, the first one to conceive, was bred August 14, 1914 to bull 1. Like the others, she was tested at regular intervals for evidences of abortion infection. The results of these tests are recorded in Table II and show that she never reacted. She calved normally May 23, 1915. Lack of pasturing facilities made it necessary to dispose of her in July, 1915.

HEIFER 129. This animal conceived to service by bull 2 on October 10, 1914. Nothing abnormal was noted throughout her gestation period. She dropped a full-term calf July 20, 1915. She was sold as a dairy cow shortly afterward, so no further tests were possible.

HEIFER 443. Service by bull 1 on September 15, 1914 failed to result in conception, but gave an opportunity for her to contract the abortion disease. When mated with bull 2 on October 28, 1914 she settled and dropped a normal, full-term calf on August 7, 1915. On September 11, 1915 she was transferred to a herd previously mentioned that was on a feeding experiment, some of which were later found to be infected. She was bred twice in October and twice in December to bull 3 and conceived December 24, 1915. The first indication of infection was on March 17 when she gave a partial agglutination reaction but did not respond to the fixation test. On April 13 she gave typical reactions to both tests. She was removed from the herd May 15, 1916 and placed in an isolated pasture so that she might be observed from time to time and so that she might have an opportunity to complete her gestation period without interference. To date, August 14, 1916, nothing abnormal has been observed except well marked lesions of granular venereal disease and a slight vaginal discharge. She will be watched with much interest until she aborts or until October 1, when she is due to calve.

HEIFER 439. This animal after two services by bull 2 had an uneventful first gestation period. On September 11, 1915 she was transferred to the above mentioned herd. On November 18. 1915 she was bred to bull 3. On January 7, 1916 she was bred to bull 4, whose history should be recalled in order to get a clear understanding of this case. As conception failed to follow these

services, she was mated with bull 5 on January 27, 1916 and is believed to be pregnant. Throughout her life she has been a consistent negative reactor and promises to remain so and deliver a normal calf early in November of this year.

HEIFER 364. This heifer was served by bull 1 August 14, 1914 but did not conceive at that time. After two trials by bull 2 she settled November 28, 1914. She has never shown the slightest sign of abortion infection, although tested regularly. Like 443, 439, and some of the others, she was placed in the herd of cattle on the feeding experiment and bred to bull 3 on December 20, 1915. As she has not come in heat since, it is assumed that she is pregnant. No evidence of infection has yet been shown by the usual tests.

HEIFER 131. This heifer has a history similar to that of 439 except that her second calf was sired by bull 4. Her serum tests had always been clear, yet very unexpectedly, on June 24, 1916, 172 days after last service, she aborted. There are four possible causes of this abortion, viz., (1) bull 3, (2) bull 4, (3) contact-infection from other cows, and (4) the ration which was deficient in certain substances that have been shown by Professor E. B. Hart [12] to be required for reproduction. Whether one or more of these causes was actually responsible has not been determined. It is important to note that the last tests made July 13, 1916, about three weeks after the abortion, were negative.

HEIFER 257. This heifer was bred to bull 2 in December, 1914 and conceived January 6, 1915. She carried her calf the full term. Two months after calving she was transferred to the herd on the feeding experiment. On January 7, 1916 she was bred to bull 4 and may have been infected by him. At any rate she did not conceive to this service, so was bred to bull 5 on January 29 and February 18 respectively. Up to February 25 she had never given the least sign of abortion infection. On that date the fixation test was positive, but the agglutination test was questionable. On March 14 this heifer was killed and her genital organs taken to the laboratory for detailed examination. The uterus was found to be normal in appearance, but was non-gravid. Culture media were seeded with material from the mucous membrane of the uterus, also from a small cyst in the left ovary. Although growths appeared

(12) Hart, E. B. The Influence of Certain Natural Feeding Materials on Growth and Reproduction. *Proc. Wis. Vet. Med. Assn.*, p. 110, 1916.

on and in the media after incubation, none could be identified as abortion bacilli.

HEIFER 128. This heifer was bred to bull 2 and everything was normal throughout her first pregnancy which terminated November 3, 1915. She was bred three weeks and again six weeks later to bull 3 but did not conceive until given service by bull 4 on January 8, 1916. The first intimation of infection was early in March when she gave an incomplete reaction to the fixation test, although the agglutination test was negative. On February 29 the herd was tested for tuberculosis and she was the only animal that reacted. A serum test at this time was indicative of abortion infection so it was decided to slaughter her, which was done on April 7, 1916. At the autopsy no macroscopic lesions of tuberculosis were found. The intact uterus was removed and taken to the laboratory for examination. It contained an apparently normal three-months fetus. Culture media was seeded with fluid from the utero-chorionic space but proved to be sterile. No evidence of "abortion exudate' was seen. Blood from the fetus was tested for abortion antibodies, but did not react.

HEIFER 130. This animal did not conceive until April 27, 1915, although given repeated service by bull 2. No sign was ever given of abortion infection, all serum tests being negative. She gave birth to a normal calf January 28, 1916, but retained her placenta. The second day after calving the badly decomposed placenta was manually removed. Septic metritis set in and resulted in death a few days later. Post-mortem examination revealed a ruptured uterus and peritonitis. It should be noted that this heifer was sick for about a week before calving which occurred 17 days before the full 285 day period had expired. However, this case would not be considered an abortion in any interpretation of the term. The blood of the four-day-old calf was tested for abortion and found to be negative.

HEIFER 440. This heifer was the only one of the lot that failed to conceive the first year, although she came in heat quite regularly and was bred to bull 2 many times. If we accept the opinion expressed by W. L. Williams[13] that the cause of heifers failing to conceive is infection of the uterus with abortion bacilli, we would have expected a reaction at some time during the two-year

(13) Williams, W. L. *Loco citato.*

period in which she has been under observation, but none was obtained. After repeated services by bull 5 she settled April 17, 1916 and is apparently safe in calf.

DISCUSSION AND CONCLUSIONS. In drawing conclusions from these data, an effort will be made to exclude everything that savors of prejudice, tradition, and superstition. Nothing will be taken for granted. Only those facts that are capable of scientific proof will be given weight. It is hoped that they will strengthen another link in the chain which is each year being drawn tighter about the epizoötiology of the abortion disease, and help, by connecting theory with practice, in our efforts to control it.

There is no question but that a bull may acquire a systemic infection by experimental inoculation and by copulation with a cow that harbors abortion bacilli in her uterine and vaginal secretions. Whether or not such an infected bull is capable of disseminating the infection by cohabitation remains to be conclusively proved. However, the soiled bulls with systemic infections used in this experiment did not transmit the abortion disease to the virgin, abortion-free heifers with which they were mated. This confirms the tentative conclusions of several other investigators, whose contributions have been mentioned, relative to the bull as a disseminator of abortion.

It has been shown that certain bulls are less susceptible to and possess a greater natural immunity against abortion infection than do heifers and cows. In some cases this is apparently a *sexual immunity*. In other cases it seems to be an *individual immunity*. The reasons for this greater protection may be: (1) A strong constitution or good conditions rather than specific bactericidal or other protective properties of their blood-serum; (2) the difference in the anatomic and physiologic arrangement of the reproductive organs of the male afforded a less favorable place for the propagation of the abortion bacilli than do those of the opposite sex. Whatever the reasons are, it is certain that something operates to exert a detrimental action on the abortion bacilli that gain entrance to the bodies of bulls which so attenuates them that they are incapable of setting up immediate infection in susceptible heifers. This theory is supported by the fact that the serum reactions given by systemically infected bulls gradually become weaker until they finally disappear entirely (Bull 2). In heifers and cows this is not the usual course of events.

The performance of bulls 1 and 2 afford grounds for the tentative conclusions that a bull acting simply as a mechanical carrier of infection, gained as a result of serving infected cows, cannot transmit the infection to susceptible cows which he may subsequently serve, if a period of a few weeks is allowed to elapse between the services.

The fact that bulls 3, 4, and 5 served heifers that later became infected and at about the same time heifers that never showed the slightest sign of infection, leads to the belief that under normal conditions the abortion disease is usually acquired from other sources than the genital organs of the bull at service. This belief is supported (1) by the previous discussion; (2) by the serum tests of the bulls which were always negative; and (3) by the fact that abortions do not occur in many cases until the seventh month of gestation, which would make the period of incubation, which is assumed to be the time that elapses between actual infection and abortion, in naturally infected cases much longer than it has been found to be in experimentally infected cases.

If a cow aborts it is far more likely that the source of her infection was another cow rather than the bull which served her, as the larger number of cows in all herds increases the opportunity for infection. The methods by which the infection may be transferred from one animal to another are the following: (1) by contaminated feed and water; (2) by licking of infected cows; (3) by smearing of infectious material upon the vulva.

SUMMARY. (1) Bulls may become infected with the abortion bacilli.

(2) Bulls with systemic infections used in the experiments were incapable of disseminating the abortion disease to virgin, abortion-free heifers by cohabitation.

(3) Bulls appear to possess a sexual or individual immunity to abortion infection that renders them less susceptible than cows and induces a more benign form of the disease.

(4) Bulls, when infected, have the ability to attenuate the infecting microorganisms in their bodies in a relatively short time, so that they will be safe for the service of non-infected cows.

(5) Cows usually acquire the abortion disease from other sources than the genitalia of bulls at the time of service.

A STUDY OF THE MILK IN BOVINE INFECTIOUS ABORTION*

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Great emphasis has been laid during recent years on the economic importance of infectious abortion in cattle. Some efforts have been made to warn milk-consumers against the possible danger to humans in drinking raw infected cows' milk. Concerning the former matter we doubt if its importance has been overestimated; concerning the latter we have doubts as to the seriousness of the situation. Whatever the merits of the various contentions may be, it is clear that we must study bovine infectious abortion both from the standpoint of the cattle industry and from the standpoint of public health. Investigations have progressed sufficiently to demonstrate the very great importance of milk in either of these lines of study. It is our purpose in this paper to call the attention of the practitioner to the points that offer something tangible in his efforts to relieve the situation and the attention of the veterinary investigator to the points that require further elucidation.

The *Bacterium abortus* occurs in variable numbers (sometimes in enormous numbers) in a large percentage of samples of market milk and consequently in the milk of certain cows has become a demonstrated fact. Efforts to isolate the organisms are not invariably successful. Both cultural and animal-inoculation methods have been employed. The cultural method devised by Nowak takes advantage of the fact that newly isolated cultures require an atmosphere partially depleted of oxygen. This atmospheric condition is obtained by growing the agar streaks from suspected material in a closed jar with *Bacillus subtilis*, having 1 sq. cm. of culture surface to each 15 c.c. of jar capacity. While one of us (L.H.C.) has isolated *Bact. abortus* from milk sediment by this method, it is too tedious a process to apply to any number of samples on account of the rapid overgrowth of the plates by fast-growing organisms of other species. The development of colonies of *Bact. abortus* requires nearly a week.

Evans isolated *Bact. abortus* from milk by plating on ordinary lactose agar to which 10 per cent of sterile blood serum was

*Presented at the meeting of the A.V.M.A., Detroit, Mich., Aug. 22, 1916.

added just before plating. After incubating for four days, the colonies which developed were transferred to nutrient broth containing 1 per cent glycerin and to tubes of whole milk containing litmus. It is interesting to note that the organisms developed more vigorously in the cream layer. Later she has stated that *Bact. abortus* may be the cause of bad flavors and odors in ripened cream. In this latter paper she reports isolating cultures of *Bact. abortus* type from 45, or 23.4 per cent of 192 samples and finding as many as 50,000 bacilli per cubic centimeter. The variety occurring most frequently in samples of milk is designated *B. abortus var. lipohyticus* because of its action on butter fat. Two other varieties were isolated but they all resemble pathogenic strains. This work is very interesting but it means to us that a great deal of work is necessary to determine the true relation of *Bact. abortus*-like cultures to the true abortion organism, or the organism that is responsible for producing the trouble in breeding cattle. Williams has already pointed out the probably almost universal distribution of *Bact. abortus* in breeding cattle. It is time that we considered something more than mere cultural studies of this organism.

The other method of study, the inoculation of guinea pigs with milk, while more reliable, is far from satisfactory, owing to the fact that it takes 8 to 10 weeks for the lesions to develop, and it is probable that the organism must be present in large numbers to cause the characteristic lesions with the 5 c.c. of milk used for inoculation. We have devised an H tube in one arm of which pure cultures of *Bact. abortus* from the lesions in the guinea pig can be isolated, while *B. subtilis* growing in the other arm will lower the oxygen tension to the proper degree if the tubes are closed with rubber stoppers.

In order to make the study of the milk more practical and more applicable to a large number of samples it was found necessary to devise new methods. Knowing that this organism is sometimes, perhaps frequently, present in considerable numbers in milk as it comes from the cow's udder, it was thought that this might indicate an infection of the udder and a consequent local production of antibodies. Consequently, agglutination and complement fixation tests were made using milk and milk serum, instead of blood serum, and *Bact. abortus*, as antigen. Since the agglutination test was found to give all the data considered valuable this test has

been adopted in all routine work to the exclusion of the complement fixation test. Dilutions ranging up to 1 to 1000 have been used and no difficulty has been experienced due to the turbidity from the use of whole milk except where dilutions less than 1 to 50 are used when rennet milk serum is substituted.

As a result of these experiments it has been shown that a pure culture of *Bact. abortus* introduced into the milk cistern of a cow's udder caused the appearance of agglutinins for this organism to appear in that quarter the following day, after which they appeared successively in each of the other quarters and finally disappeared. It is of interest to note here that we have in no case found any evidence to support the belief that *Bact. abortus* produces any gross or macroscopic lesions in the cow's udder. We have data which point to the conclusion that there is an increase in the number of leucocytes and antibodies in the strippings over that in the fore milk from those quarters that give a milk highly pathogenic for guinea pigs. In other words, there appears to be antigenic action without pathogenic action. In every case in which *Bact. abortus* was found present in the milk by guinea pig inoculations the agglutinins for this bacterium were also found, but the bacterium was not found in every case in which agglutinins were demonstrated. Either of two explanations seems possible. The organism may be present in the udder in all cases, giving as active, local production of antibodies, but in too small numbers to be demonstrated by the animal inoculation method used, or the presence of antibodies in the blood may give rise to their presence, passively, in the milk. The importance of the whole matter rests in the question of the effect of the consumption of such milk on the human being and on the young bovine.

Certainly the agglutination test is of value as the simplest method of studying the presence of *Bact. abortus* in milk, and if the organism eventually proves pathogenic for humans this test may be of value as another means of safeguarding certified and all unpasteurized milk. Furthermore, if the milk of certain cows is responsible for furthering the spread of abortion because of its action on calves, it may prove more profitable for the veterinarian to assist the cattle breeders in picking out and rejecting unsafe cows than in advising universal pasteurization or sterilization of the milk fed to calves. The agglutination test of the milk may prove to be helpful in this connection.

In a large herd of Holsteins five cows were examined in our presence by Dr. Williams. All were failing to breed and there was a history of abortion in the herd. Three had cystic ovaries and three had chronic endometritis. The blood of three reacted to the complement fixation test and the milk of four reacted to the agglutination test. One cow giving no history of abortion reacted to neither test. It would appear from these results that an examination of the milk by the agglutination test might be of value in determining the nature of many cases of sterility in cattle, i. e., it might indicate an involvment of *Bact. abortus.*

A number of investigators have been led to fear that milk containing *Bact. abortus* might be dangerous for human beings, especially for children whose principal food is often raw cows' milk. Melvin says in this connection: "This bacillus may prove to be another danger in the use of raw milk as food, and may furnish an additional reason for taking advantage of the safeguard afforded by pasteurization". Mohler and Traum, in studying the pathogenicity of this organism to man, examined the sera of forty-two human beings by complement fixation and agglutination tests, using *Bact. abortus* as antigen with negative results. They also inoculated material from fifty-six tonsils and adenoids into guinea pigs and produced nodules in the liver of one guinea pig from which no cultures were obtained and distinct lesions in the liver, spleen and testicles of another guinea pig from which *Bact. abortus* was obtained. We are not satisfied that this proves the pathogenicity of the organism to man.

Larsen and Sedgwick have made an extended study of human infection by this organism. They were able to demonstrate seventy-three positive complement fixations out of four hundred and twenty-five cases examined. It occurred to them to ask the question: Are these antibodies in the blood of children the result of an active or passive immunity? They were unable to demonstrate the presence of antibodies in the milk of aborting cattle. In their later investigations they found that new-born children who had not received cow's milk gave negative blood reactions in all of forty-two cases tested. One infant, taken from the breast on the seventh day after birth and fed cows' milk, gave a positive reaction on the twenty-first day. Positive reactions were obtained in two children with enlarged spleens; children with many common diseases of childhood, including rickets, gave negative reactions.

Nicholl and Pratt have obtained positive agglutination reactions with the blood of some children. They say that the serum reactions are suggestive but not conclusive, failing the isolation of the bacillus. Ramsey examined the blood of fifty-eight boys and an equal number of girls, of whom six boys and one girl gave positive reactions to the complement fixation test.

We have shown that antibodies from *Bact. abortus* may be present in great concentration in cows' milk and may be confined to one quarter. The fact that antibodies are often present in milk leads us to suspect that the cases in which the appearance of antibodies in the blood of children has been looked upon as indicating infection are more probably due to a passive immunity resulting from the absorption of antibodies contained in the milk.

An examination was made of the blood of a number of persons drinking raw milk, pasteurized milk and no milk. Of six persons who had been drinking raw milk or cream previous to the test three gave reactions to both complement fixation and agglutination tests. Of four persons drinking pasteurized milk one gave a reaction to the former test only. All four who had been drinking raw milk gave negative reactions.

To determine whether *Bact. abortus* antibodies could be made to appear in the sera of adults by ingestion of infected milk a feeding experiment was arranged. Cows were selected whose milk had a high *Bact. abortus* antibody content and caused *Bact. abortus* lesions and blood reactions when five cubic centimeters were inoculated into the abdominal cavity of guinea pigs. During the experiment each person was drinking, for a period of eight weeks, about a pint and a half of this milk. The antibody content of the human serum was determined before beginning the consumption of milk, during the period of milk consumption and four weeks after this period. Of the seven persons drinking the milk five developed a slight increase in antibody content of the blood but in no case was there a marked increase. In only one case did the reaction persist after four weeks from the last drinking of the infected milk. Another experiment was conducted to throw some light on the pathogenic or antigenic properties of *Bact. abortus* in milk on humans. Negative milk to which was added 10 c.c. of a 48 hour culture of *Bact. abortus* was consumed daily in quantities of one pint by two adult males for a period of six weeks. There was no appreciable increase in the antibody content of the blood of either individual and no untoward effects observable.

If the *Bact. abortus* antibodies present in the blood were due to an infection of the individual by organisms being present in the milk, it seems that we could expect a fairly high and lasting antibody content; but if the antibodies are due to a passive immunity, we could expect but a weak reaction, which would persist for but a short time after one had ceased drinking the milk. It is probable, therefore, that the antibodies in the human blood represent a passive immunity due to their absorption from the milk. There seems to be little evidence to warrant a statement that *Bact. abortus* in milk is either pathogenic or antigenic to any marked degree for the human adult at least.

We wish to call your attention to some of the results of a long series of experiments conducted by one of us (I. F. H.) with guinea pigs, rabbits and calves, involving the use of milk reacting and not reacting to serological tests for *Bact. abortus* antibodies.

We have found no records in the literature relating to the feeding of milk in this connection to either guinea pigs or to rabbits, all such work having involved injections which are so unnatural as to shed no light on the real problem. However, Schroeder stated in the discussion of a paper read before the American Medical Milk Commission that he and Cotton have not only produced the abortion disease in guinea pigs by injecting them, but have successfully produced the disease in guinea pigs by feeding them upon seemingly normal milk from apparently healthy cows that had become chronic carriers of the abortion injection. Schroeder has not given any experimental data concerning the above statement.

Out of 18 guinea pigs fed on naturally infected milk, i. e., milk reacting to serological tests and producing lesions typical of *Bact. abortus* in guinea pigs when injected intraperitoneally, there occurred one abortion and two abnormal parturitions, one case with one stillbirth and one with two stillbirths. The guinea pigs were fed over periods ranging from 33 to 287 days daily with the infected milk which was tested every 14 days for antibodies. Only 2 or 11 per cent of the 18 guinea pigs developed antibodies, one at the time of autopsy and one 8 days before autopsy only which was at the time of parturition when one dead fetus and 3 live young were delivered. Two controls on non-infected milk and two on no milk remained negative. Two guinea pigs were fed on negative milk plus cultures of *Bact. abortus* and both developed antibodies, but no lesions.

We feel, therefore, that there is not sufficient evidence to condemn positive milk as dangerous to guinea pigs by ingestion since it has shown no pathogenic action and only slight antigenic action.

Fourteen normal rabbits, pregnant and non-pregnant females were fed naturally infected milk for a period of 124 days. Blood tests were made at intervals of 14 days. Of 4 controls 2 were fed non-infected milk and 2 no milk. The controls gave the same reactions and partial reactions given by the 14 on infected milk. These reactions are probably non-specific as shown by Kolmer and others, and due to a peculiarity of rabbit serum, a fact which renders the rabbit unfit for accurate work of this nature. Only one out of the 14 rabbits gave an increase in antibody content during the 124 day period and this reaction persisted in spite of a suspension of feeding for a period of 84 days. No lesions were found in any of the rabbits on autopsy.

Six rabbits were fed non-infected milk plus a culture of *Bact. abortus* daily. Antibodies developed to a maximum on the forty-second day and on the fifty-second day a weakened reaction was in evidence. The strength of the reaction weakened at subsequent tests becoming negative in four of the six at the eighty-fourth day although the mixture was being consumed throughout the entire period. Two litters of young were born to each rabbit during the experiment. No abortions occured in any of the rabbits, nor were there any lesions in any of the rabbits when autopsied. We therefore, feel safe in concluding that positive milk is not dangerous to rabbits by ingestion, since no pathogenic action and very slight antigenic action results therefrom.

That new-born calves may acquire an infection through the ingestion of milk has never been proven to occur, nor has it been proven not to occur. Williams has made some investigations on the possibility of calves acquiring an infection through the ingestion of raw milk, but his results are far from being conclusive.

Fourteen new-born calves were selected for the experiment Six calves were fed upon a naturally infected milk, 6 upon non-infected milk, 1 upon pasteurized infected milk and 1 upon non-infected milk plus 5 c.c. of a 48 hour culture of *Bact. abortus* with each feeding. One gallon of the milk was fed twice daily to each calf for a period varying from five to fourteen weeks. Each of the calves (excepting those fed non-infected milk) were separated from their respective dams at the time of birth. The calves were

never allowed to suckle their dams, thus eliminating a possible infection from material which might collect on the surface of the udder and teat that would not be present in the milk.

The calves which were fed non-infected milk were allowed to suckle their dams from 3 to 4 days after birth and then separated.

The blood of each of the calves (excepting two) was tested for *Bact. abortus* antibodies before the milk was fed.

Bull calf 995A was fed upon the naturally infected milk of its dam for a period of 13 weeks. The blood of the calf was negative before feeding. A slight reaction developed one week after feeding. A high antibody index developed at the end of the second week which remained until the end of the 3rd week. At the end of the 4th week the blood was negative and remained negative during the remainder of the time of feeding.

No matting or staining of the sexual hairs occurred during the time of the feeding of the milk. However, 3 weeks after the feeding of milk was discontinued, the sexual hairs became matted and stained. A microscopical examination of sediment collected from the matted hairs showed only epithelial cells, uric acid crystals and many bacteria. No pus cells were found.

The dam of calf 995A was about 2 years old at the time of giving birth to this calf. The blood of the dam was negative before parturition. The milk was positive before parturition. Both blood and milk were positive after parturition and have continued to remain positive up to this writing. Her milk produced lesions and *Bact. abortus* antibodies when inoculated intraperitoneally into guinea pigs.

Bull calf 1001A was fed upon the naturally infected milk of its dam for 5 weeks. The dam was 7 years old. She has given birth to 5 normal calves. No abortions have occurred. No test was made on the blood before calving. The milk was negative before calving. The blood was slightly positive and the milk strongly positive after calving.

The blood of the calf was positive at the time of birth and remained positive up to the third week after birth. The blood was negative when tested at the end of the 4th week and remained negative during the remainder of the time tested.

The sexual hairs of the calf became slightly matted and stained on the 2nd week after birth. A microscopical examination of the sediment from the matted hairs showed only epithelial cells, uric acid crystals and bacteria. No pus cells were found.

The remaining four calves which were fed upon naturally infected milk gave no reactions, each calf being fed upon the milk for a period of 13 weeks. At no time did the sexual hairs show any tendency to become matted or stained during the time of feeding. The blood and milk of the dams of the above calves were negative before and after calving.

The milk fed to the above 4 calves was the mixed milk from three cows. The milk and blood of each cow has given a positive reaction for more than 18 months. Each of the three cows has aborted one or more times. The milk of each of the cows, when inoculated into guinea pigs, produced lesions and *Bact. abortus* antibodies, and *Bact. abortus* was isolated from the diseased spleen of the inoculated guinea pigs.

One calf (calf 1004A) fed upon non-infected milk for a period of 12 weeks developed *Bact. abortus* antibodies at the time of birth. The blood continued to give a reaction up to the 4th week after birth. The blood was not tested again until the 9th and 12th week after birth. Both tests were negative. No matting of the sexual hairs occurred.

The dam of the above calf was eight years old. She has given birth to 6 normal calves. The calf of the second pregnancy was aborted. No tests were made on the blood and milk before calving, both were negative at the time of calving.

Three of the new-born calves which were fed upon non-infected milk for 12 weeks never reacted, nor was there a tendency for the sexual hairs to become matted. The dams of the 3 calves have never aborted, nor has the blood and milk been known to give a positive reaction.

Two calves (1008A and 1009A) were allowed to suckle their dams for 4 days after birth and then fed upon a non-infected milk. The calves were 2 weeks and 8 weeks old respectively when the first blood test was made. Each of the calves gave a positive reaction when first tested and remained positive during the 5 weeks the tests were made. No matting of the sexual hairs occurred.

The dams of the two calves are 5 years old. Neither cow has ever aborted. The blood and milk of each dam was positive at the time the above calves were born.

The above results strongly emphasize the necessity of testing the blood of calves at the time of birth in order to differentiate

between positive reactions due to the ingestion of infected milk and positive reactions present at time of birth.

The calf fed upon pasteurized, naturally infected milk gave no positive reactions. No matting of the sexual hairs occurred during the time of feeding. The dam of this calf was two years old. The blood and milk of the dam has never given a reaction.

The calf fed upon non-infected milk plus a culture of *Bact. abortus* gave a negative reaction at the time of birth. A high antibody index had developed when the blood was tested one week after the beginning of the feeding of the mixture. The antibody index remained constant for 4 weeks. The reaction began to decrease on the 5th week. The blood became negative on the ninth week and remained negative during the remainder of the time the feeding of the mixture was continued.

The dam of this calf is 4 years old. She has had two normal births and one abortion. The blood and milk were negative before calving. The cow died of milk fever two days after calving. There were no tests made of the blood and milk after parturition.

The sexual hairs of the calf did not show any matting or staining during the time of feeding and the calf remains apparently healthy to date.

We feel that we must conclude from the data submitted that there is no connection, whatever, between the feeding of infected or non-infected milk and the matting and staining of the sexual hairs of new-born calves.

That *Bact. abortus* antibodies develop in calves as a result of ingesting naturally infected milk seems to us to be a demonstrated fact, but the cause and significance of the appearance of the antibodies cannot be explained until further development of the studies on the calves. The antibodies may be due to an active infection, they may be due to an active immunity or they may be due to a passive transmission of the antibodies present in the milk.

The possibility of infections being acquired *in utero* seems to us to be a phase of the abortion question that should be given as much attention as other possible modes of infection. Since we have found that 16 per cent of the 12 calves used in this experiment possessed *Bact. abortus* antibodies at the time of birth and that the antibodies persisted for many weeks after birth, we conclude that the control of the disease must begin with a study of the calf at the time of birth.

It occurred to one of us (I. F. H.) that naturally infected milk might be highly bactericidal for *Bact. abortus,* thus being capable of destroying *Bact. abortus* after sufficient time has elapsed for bactericidal action to take place.

In order to demonstrate this point an experiment was performed in the following manner:

A milk which contained *Bact. abortus* antibodies was heated intermittently for one hour at 60°C. on three successive days in order to destroy all microorganisms present. Two c.c. of bouillon were placed in small sterile test tubes and to these were added in order: .2, .1 and .05 c.c. of milk, 24,000 *Bact. abortus* organisms and .1 c.c. of complement serum. Two controls were used, one containing bouillon, .2 c.c. of milk and 24,000 bacteria, the other containing only bouillon and 24,000 bacteria. The tubes were incubated for 2 hours at 37°C. . 1 c.c. of the mixture from each tube was plated out before, and .1 c.c. after incubation. The tube that contained .2 c.c. of milk contained 1200 bacteria after incubation. The remaining tubes were sterile. The control tubes contained 48,000 bacteria. We, therefore, feel safe in concluding that milk containing *Bact. abortus* antibodies is highly bactericidal for *Bact. abortus.* Therefore, milk containing *Bact. abortus* antibodies that has been heated at a sufficient temperature to kill the organisms and not the antibodies should be looked upon as being beneficial to new-born calves. The milk containing antibodies should give the calf a passive immunity during its early development.

Full bibliography may be found in:

L. H. COOLEDGE. Agglutination test as a means of studying the presence of Bacterium abortus in milk. *Jour. Agr. Res.,* Vol. V, No. 19.

L. H. COOLEDGE. Is Bact. abortus (Bang) pathogenic for human beings? *Jour. Med. Res., N. S.,* Vol. XXIX, No. 3.

Dr. E. M. Nighbert has been transferred from Atlanta, Georgia, to Jacksonville, Florida, where he will locate as inspector in charge of the work of the Bureau of Animal Industry in the eradication of cattle ticks in cooperation with the State authorities. The work in Florida heretofore has been directed from the Atlanta office, but Dr. Nighbert will be assigned with a corps of veterinarians to Jacksonville and will devote his entire attention to encouraging the building of dipping vats and supervising the building of such vats for the eradication of cattle ticks in this State.

FURTHER STUDIES ON HOG CHOLERA WITH REFERENCE TO SPIROCHAETA HYOS*

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INTRODUCTION. Several reports have been published relative to various studies on *Spirochaeta hyos*, an organism present in certain hog cholera lesions. The investigation, which is still incom plete, has been continued since the publication of the first preliminary paper in 1912. The present paper has been prepared for the purpose of reporting additional data and presenting a general summary of the investigation.

EXPERIMENTAL NOTES. *Presence of Spirochaeta hyos in blood of cholera infected hogs.* The study of spirochaetes found in swine was prompted by the results of early observations on the blood of cholera infected hogs which were reported [1] [2] as follows:

"In the specimens of blood from all infected hogs, which have been observed by means of the dark field, a relatively large spirochete has been found. It averages from five to seven microns in length and one micron in width. The body of the organism is flexible and round at its ends. It presents no knobbed appearance at its poles. Actively motile, it revolves about its longitudinal axis. Its motility is undulating in character and its spirals are fixed. A few of these organisms have been observed dividing longitudinally. In one permanent microscopical mount, prepared by India ink fixation, one of these organisms apparently shows a polar flagellum. On the dark field this spirochete is readily distinguished from bacteria on account of its lack of rigidity and its characteristic motility, and from 'blood filaments' by its greater refractive properties and characteristic morphology.

"This spirochete has not been found in large numbers, in any of the blood preparations. However, in nearly every specimen examined, more than one have been observed and in many cases five or six have been found with little difficulty. As a rule the organisms have been found to be more numerous at the height of the disease. The specimens of blood examined have been diluted in the proportion of about one to ten or fifteen with sterile sodium citrate solution, which factor should be considered in contemplating the number observed in a given positive specimen. Moreover, it is suggested that this organism, when observed as a spirochete form, constitutes only one stage of its development."

*Read before the meeting of the Am. Vet. Med. Assn., Detroit, 1916.

Since reporting the blood findings resulting from the microscopical study on the dark field, no further data on this phase of the problem has been published. Subsequent work dealt with studies of spirochetes in the intestinal mucosa and local lesions, cultural studies, filtration and inoculation experiments and complement fixation tests. On numerous occasions, however, attempts were made to secure satisfactory stained preparations as well as cultures of the spirochete from the blood. These attempts were wholly unsuccessful. No growth of the spirochete occurred in cultures made from the blood in various special deep tube media, such as serum, blood, agar, ascitic and amniotic fluid in various combinations. A few months ago attention was directed to this particular phase of the problem because it seemed necessary not only to verify the results of the microscopical study of the blood, but also to investigate the possibility of securing pure cultures of the spirochete directly from the blood of cholera infected hogs.

Pure cultures of *Spirochaeta hyos* may be obtained from the intestinal ulcers or local lesions of cholera infected hogs by making repeated transfers from the original culture. Owing to the period of time necessary to eliminate contaminating organisms from the original cultures, the final transfers containing the spirochetes in pure culture, are often unsatisfactory for animal inoculation experiments. This is an assumption based upon the probable attenuation of the cultures because of long continued passage on artificial culture media. Since the spirochete had been found in the blood by means of the dark field, it appeared that by proper methods the organisms might be isolated in pure culture directly from the blood and thus afford unattenuated cultures for animal inoculation and other experiments. Failure to grow the spirochetes from the blood in tube media led to the use of mass cultures.

CULTURE MEDIA. The culture media used for the earlier blood cultures consisted of a mixture of 100 c.c. of veal bouillon, (5 points acid to phenolphthalein); 50 c.c. sterile ascitic fluid and 25 c.c. of 2% veal agar in a flask containing 4 or 5 small pieces of fresh, sterile rabbit testicle or kidney tissue. Considerable difficulty was encountered in putting up this media due to the nature of the ingredients, and the impossibility of sterilizing the mixture. Other formulae, using varying amounts of the same material, with and without sterilization, were tried later.

Owing to the difficulty in obtaining ascitic fluid in a sterile condition, attempts were made to replace it with amniotic fluid obtained from pregnant sows slaughtered at the abattoir. This was used both with and without sterilization and in approximately the same amounts as the ascitic fluid. Some promising results were obtained, but it was not found to be as satisfactory as the ascitic fluid. Fluid obtained aseptically and used without sterilization, gave much better results than that sterilized.

The formula determined upon for use in the later cultures was as follows:

Ascitic Fluid.....	40 c.c.
Amniotic Fluid	50 c.c.
Agar	25 c.c.
Bouillon 100	c.c.

These ingredients were mixed in a 250 c.c. flask to which the tissue had been added and the whole mixture was autoclaved.

TECHNIC INVOLVED IN MAKING CULTURES. (1) Tail bleedings; the tail was washed carefully with mercuric iodide soap, shaved and treated with a mixture* of alcohol, acetone and coal tar product, possessing high phenol coefficient. The end of the tail was then cut off and the blood caused to flow in a thin stream directly into the culture flask.

(2) Aspiration from the heart; the skin over the heart was washed, shaved and painted with iodine. Then by means of a sterile syringe fitted with a long needle, the blood was aspirated directly from the heart and forced into the flasks from the syringe.

(3) Slaughter bleeding; the animal was stunned by a blow on the head, the thorax quickly opened and the blood sample aspirated from the pulsating heart by means of a sterile 25 c.c. pipette.

In all cases, at least 25 c.c. of blood were taken, if possible, and after mixing with the media a layer of sterile neutral oil was added. When the blood was drawn, control cultures were made on nutrient agar and bouillon, to aid in determining its sterility.

INCUBATION AND EXAMINATION OF CULTURES. The cultures were incubated at 37° for several weeks. Examination by means of the dark field were made at intervals of a day or two for some

*See article by McDonald, *Jour. Surgery Gynecology and Obstetrics.*, Vol. 21, July-1915, p. 82.

time and then at less frequent intervals. Whenever the spirochetes developed, they were found from four to twenty-nine days after the cultures were made.

The contaminating organisms consisted of *B. coli communis, B. cholerae suis, B. enteritidis, B. subtilis,* staphylococci, streptococci, and several unidentified bacilli and spirilla.

When the cultures showed growth of active spirochetes, transfers were made into ascitic agar tubes, containing tissue. In some instances, owing to the presence of very rapidly growing bacteria with gas production, the spirochetes did not develop and usually the purification was most difficult.

STRAINS OF VIRUS UTILIZED. Four strains of virus have been used in these experiments:—

1—New York, received from Drs. Moore and Birch of Cornell University.

2—St. Louis, received from Dr. Hauk of East St. Louis, representing stock strain built up by mixing together all the strains of virus obtainable.

3—Wisconsin, received from Drs. Hadley and Beach of the University of Wisconsin.

4—Grosse Isle, obtained from a herd of cholera infected hogs at Grosse Isle, Mich.

TABLE I.

GENERAL DATA, BLOOD CULTURES.

No.	Flask	Hog No.	Strain Virus	Character of bleeding	No. days after inoc. when cults. made	No. Days before Spirochete observed
1		248	N. Y.	Heart (1)	15	11
2		254	St. L.	Tail	8	
3		256	Wis.	Tail	8	
4		251	St. L.	Heart (1)	16	11
5		254	St. L.	Heart (2)	18	9
6		261	N. Y.	Tail	10	
7		256	Wis.	Heart (2)	18	
8		259	Wis.	Tail	10	9
9		255	N. Y.	Tail	20	
10		258	G. I.	Tail	12	
11		259	Wis.	Heart (2)	13	29
12		257	G. I.	Heart (2)	22	6
13		255	N. Y.	Heart (1)	24	
14		262	St. L.	Tail	4	
15		265	G. I.	Tail	4	

No. Flask	Hog No.	Strain Virus	Character of bleeding	No. days after inoc. when cults. made	No. Days before Spirochete observed
16	263	Wis.	Tail	7	
17	264	N. Y.	Tail	7	
18	261	N. Y.	Heart (2)	20	29
19	258	G. I.	Heart (2)	20	
20	252	N. Y.	Heart (2)	36	
21	265	G. I.	Heart (2)	9	
22	262	St. L.	Tail	10	
23	263	Wis.	Tail	10	8
24	263	Wis.	Tail	12	18
25	264	N. Y.	Heart (2)	12	6
26	267	St. L.	Tail	5	
27	263	Wis.	Heart (1)	15	
28	262	St. L.	Heart (1)	17	9
29	266	N. Y.	Tail	10	
30	267	St. L.	Tail	10	
31	268	G. I.	Tail	10	
32	269	Wis.	Tail	10	
33	266	N. Y.	Heart (1)	16	4
34	267	St. L.	Heart (1)	16	
35	270	St. L.	Tail	8	
36	271	N. Y.	Tail	8	
37	273	G. I.	Tail	8	
38	269	Wis.	Heart (1)	22	4
39	272	Wis.	Tail	10	
40	271	N. Y.	Heart (1)	14	
41	273	G. I.	Heart (3)	15	
42	270	St. L.	Heart (3)	16	
43	278	Normal	Tail		
44	279	Normal	Tail		
45	280	Normal	Tail		
46	277	Normal	Tail		
47	272	Wis.	Heart (1)	18	12
48	268	G. I.	Heart (3)	28	6
49	277	G. I.	Heart (1)	3 or 4	
50	279	St. L.	Heart (3)	5	
51	281	Normal	Tail		
52	280	N. Y.	Heart (3)	6	12
53	270	St. L.	Heart (3)	23	
54	273	G. I.	Heart (1)	24	
55	279	St. L.	Heart (3)	8	
56	287	Normal	Heart (3)		
57	286	Normal	Heart (3)		
58	278	Wis.	Heart (3)	7	
59	281	G. I.	Heart (3)	9	
60	275	N. Y.	Heart (3)	7	
61	287	Wis.	Heart (1)	8	
62	285	G. I.	Heart (3)	11	
63	286	St. L.	Heart (3)	11	
64	281	G. I.	Heart (1)	10	
65	285	G. I.	Heart (3)	15	
66	286	St. L.	Heart (2)	15	9
67	287	Wis.	Heart (1)	18	*95

*Culture not examined after 19 days.

No. Flask	Hog No.	Strain Virus	Character of bleeding	No. days after inoc. when cults. made	No. Days before Spirochete observed
68	284	N. Y.	Heart (3)	12	7
69	278	Wis.	Heart (4)	20	5
70	294	St. L.	Heart (3)	6	†90
71	291	N. Y.	Heart (3)	7	
72	293	G. I.	Heart (3)	8	
73	292	Wis.	Heart (3)	9	
74	294	St. L.	Heart (3)	12	
75	293	G. I.	Heart (3)	12	
76	291	N. Y.	Heart (3)	14	6
77	293	G. I.	Heart (3)	16	6
78	294	St. L.	Heart (3)	16	6
79	291	N. Y.	Heart (4)	19	7
80	300	St. L.	Heart (3)	10	6
81	298	G. I.	Heart (3)	11	
82	301	N. Y.	Heart (3)	12	
83	299	Wis.	Heart (3)	12	
84	300	St. L.	Heart (4)	13	
85	299	Wis.	Heart (4)	16	5
86	298	G. I.	Heart (4)	16	15
87	304	St. L.	Heart (3)	9	7
88	303	G. I.	Heart (3)	10	
89	305	N. Y.	Heart (3)	12	
90	302	Wis.	Heart (3)	13	13
91	288	St. L.	Heart (3)	23	
92	304	St. L.	Heart (3)	16	10
93	290	Wis.	Heart (2)	18	
94	297	Wis.	Heart (2)	18	23
95	295	Wis.	Heart (3)	18	5
96	306	St. L.	Heart (2)	38	17
97	312	N. Y.	Heart (2)	10	8
98	313	St. L.	Heart (2)	10	18
99	311	G. I.	Heart (2)	12	12

†Culture not examined after 22 days.

(1) Blood taken from the heart with 25 c.c. pipette after death.
(2) Blood taken from the heart with 25 c.c. pipette while animal was stunned.
(3) Blood aspirated from the heart by syringe while animal was alive.
(4) Blood taken from the heart by syringe after death.

A summary of the results shown in TABLE I may be expressed as follows:

1. No spirochetes could be found in cultures made from the blood of normal hogs although contaminating bacteria were present in practically all cases.
2. No spirochetes were observed in blood cultures made from 1–5 days after inoculation of hogs with the filterable virus.
3. 15.8 per cent of total blood cultures made from 6–9 days after

inoculation of pigs with the filterable virus resulted positively.

4. 50 per cent of total blood cultures made 10 or more days after inoculation gave positive findings.
5. 53 per cent of total blood cultures made after death from hog cholera contained *Sp. hyos.*
6. *Sp. hyos* were observed in all positive cultures from 4 to 29 days after cultures were made, with two exceptions.

It should be borne in mind that the foregoing series includes all mass blood cultures since the beginning of the work.

For the first several weeks considerable experimentation was carried out for the purpose of developing the most satisfactory culture media formula, correcting errors in technique and devising the best methods for the elimination of contamination, in so far as possible. Notwithstanding these difficulties 40 per cent of the total blood cultures showed the presence of *Sp. hyos.* Most of the cultures, especially those in the first part of the series, contained many contaminating organisms and it is quite probable that in some instances the spirochetes may not have developed because of overgrowth of extraneous forms.

It is practically impossible to secure relatively large blood specimens from the hog, uncontaminated, therefore undue importance cannot be attached to the foregoing results. However, the general results corroborate those previously reported from the dark field study of the blood of normal and cholera infected hogs.

Pathogenicity of Spirochaeta Hyos. References have been made in published data [3] [4] to the successful production of symptoms and lesions similar to those of hog cholera by means of inoculation with contaminated and pure cultures of *Sp. hyos.* A summary of these reports is presented in Table II.

TABLE II.

SUMMARY OF PUBLISHED DATA, ANIMAL INOCULATION EXPERIMENTS.

Hog	Character of Cult. of Sp. Hyos: Pure or contam.	No. of generation on cult. media	Age of transfers days	Results
559	contam.	1st	5	Disease typical of H. C. Check animal inoc. with contam. cults., remained normal. Berk. filtered serum. 559 produced disease similar to H. C.
622	contam.	2nd	57	Mild reaction.
623	contam.	2nd	57	Mild reaction.
612	contam.	2nd	22	Disease typical of chronic cholera. Berk. filtered serum. 612 produced disease similar to H. C.
613	contam.	2nd	22	Disease typical of H. C. Berk. filtered serum. 613 produced same in normal pig.
614	contam.	2nd	22	Disease typical chronic chol. Berk. filtered serum. 614 produced symptoms similar to those of mild chol.
627	contam.	3rd	36	Strong reaction, gained resistance against H. C.
628	contam.	3rd	36	Strong reaction—blood produced disease typical of H. C.
642	contam.	3rd	52	Disease typical of mild cholera.
643	contam.	3rd	52	Disease typical of mild cholera.
805	pure from filtrate	2nd	70	Disease typical of H. C. Controlled by check animal.
806	Pure from filtrate	2nd	70	Disease typical of H. C. Controlled by check animal.

During the past year 27 hogs have been subjected to inoculation experiments with *Sp. hyos.* The methods used in conducting these experiments and in controlling the results are illustrated by the following laboratory data:

EXPERIMENT II.—Hog 121 received injections of pure cultures of *Sp. Hyos* as follows:

Hog 121—5-27-15. Intramusc. Inj. 6 c.c. susp. trans. II 112
6-1 -15. Intramusc. Inj. 5 c.c. susp. trans. III 112
6-4 -15. Intramusc. Inj. 4½c.c. susp. trans. III 112
6-8 -15. Intramusc. Inj. 8 c.c. susp. trans. III 112

Repeated inoculations of pure cultures were made for the purpose of comparing results with those from single inoculations. Flexner[5] and his associates found that several intraperitoneal and

intraspinal inoculations of monkeys with cultures of the organism which they have isolated from cases of acute anterior poliomyelitis, were required to produce infection.

This animal showed a thermal and constitutional reaction 6-2-15 to 6-6-15, after which it regained normal conditions. Subsequent exposure to the filterable virus proved that it was immune to hog cholera.

Hog 123 received injections of pure culture of *Sp. hyos* as follows:

Hog 123—	5-27-15.	Intramusc.	Inj.	4½c.c.	susp. trans. II	112
	6-1 -15.	Intramusc.	Inj.	4 c.c.	susp. trans. III	112
	6-4 -15.	Intramusc.	Inj.	5 c.c.	susp. trans. III	112
	6-8 -15.	Intramusc.	Inj.	10 c.c.	susp. trans. III	112

This animal showed very slight reaction from the cultures injected 6-2 – 6-5, on 6-8 exhibited marked symptoms similar to those of the subacute type of hog cholera and died 6-23-15.

FIG. 1. Kidney.

Hogs 122 and 124 were placed with hogs 121 and 123 at the beginning of the experiment, 5-27-15.

Hog 122 on 6-10-15 developed symptoms typical of H. C. which proved fatal in 18 days. It is significant to notice that this animal showed symptoms just 6-7 days after hog 121 exhibited a strong reaction from injection of cultures.

Hog 124 remained normal until 6-16, 7-8 days after hogs 123 and 122 manifested symptoms, evidently not becoming exposed from 121 at the same time as hog 122. With the exception of 121 all suffered from disease processes typical of H. C.

Autopsy Hog 122.

Pericardial sac—ecchymotic spots.
Heart muscle—irregular hemorrhagic areas.
Lungs—small hemorrhagic areas.
Spleen—enlarged, soft and engorged.
Glands, mediastinal, inguinal and mesenteric—enlarged and hemorrhagic.
Kidneys—petechiae, "turkey egg". See fig. (1).
Cecum—Mucosa ulcerated around ileo-cecal valve. Small hemorrhagic areas. See fig. (2).

Autopsy Hog 123.

Lungs—hemorrhagic areas.
Spleen—very large and friable.
Glands—mesenteric and inguinal enlarged.
Kidney—few ecchymotic spots.
Cecum—two small ulcers.
Liver—normal.
Heart—normal.

Autopsy Hog 124.

Lesions correspond with those found in hog 122 with the addition of petechiae on the ental surface of the bladder. See figs. (3), (4), (5).

EXPERIMENT 12.—Hog 131 received 12 injections of liquid cultures of *Sp. hyos* during a period from 6-15 – 7-25-15. The animal remained in normal condition and was found later to be immune to hog cholera.

Hog 132 placed in the same pen as a control throughout the experiment also remained normal and was found to be immune upon exposure to the filterable virus of H. C.

Hog 133—Another control, remained normal or nearly so for almost two months and then gradually developed symptoms characteristic of the chronic type of hog cholera to which it succumbed 9-8-15. Autopsy showed characteristic lesions.

Hog 134 received 12 injections of liquid cultures of *Sp. hyos* during a period from 6-15 – 7-28. As a rule this animal showed thermal reactions after each injection, manifested symptoms 8-3-15 and died 9-9-15. The autopsy showed lesions similar to those of H. C.

Hogs 137 and 138 were given 7 injections and fed cultures of *Sp. hyos* during a period from 6-15 – 7-12. After about 11 weeks both of these animals manifested symptoms of disease.

No. 137 recovered and proved immune to hog cholera.

No. 138 died of a chronic type of disease similar to H. C. 9-17-15. The experiments on these animals (137 and 138) were controlled throughout by the presence of normal hogs (135 and 136) which developed an immunity to the filt. virus of H. C., presumably through exposure to the attenuated organisms causing disease in 137 and 138. The accompanying photograph (see fig. 6) shows the condition of the animals included in this experiment on 9-10-15.

FIG. 2. Cecum.

Hogs 133 and 137 do not appear in the photograph as No. 133 died on 9-8 and was destroyed while No. 137, in normal condition, was not in the field of the camera. Hog 134 had died the previous day, while hog 138 was very sick.

TABLE III.

SUMMARY OF UNPUBLISHED DATA.
ANIMAL INOCULATION EXPERIMENTS.

Hog. No.		Character of Cult. of Sp. Hyos.			Result of Experiment
		Pure or Contam.	No. of generation on cult. med.	Age of Transfers. (days)	
1	53	Cont.	2	9	Acute disease, died 14th day.
2	56	"	2	18	Subacute disease, died 17th day.
3	58	"	5	5	Chronic disease, died, control, acute type.
4	78	Pure	16	8	Subacute, died 23rd day, control died.
	79	"	16	8	Chronic, died, control died.
5	82	"	16	8	Chronic, died, control died.
6	83	"	18, 19 & 20	4, 7, 20, 30	Not affected by cult., died after exposure to filt virus.
	92	"	18, 19 & 20	4, 7, 20, 30	Not affected by cult., died after exposure to filt virus.
7	95	"	4 & 5	6, 22, 25, 28	Not affected by cult., died after exposure to filt virus.
	97	"	4 & 5	6, 22, 25, 28	Immunized by cult. to filt. virus.
8	103	"	7, 8, & 9	3, 20, 23	Immunized by cult. to filt. virus.
	104	"	7, 8, & 9	3, 20, 23	Died of subacute disease.
9	108	"	10 & 11	4, 7, 11	Not affected by cult., died after exposure to filt. virus.
	110	"	10 & 11	4, 7, 10	Not affected by cult., died after exposure to filt. virus.
10	115	"	6	22, 28	Chronic disease, died, controls, acute disease.
	116	"	6	22, 28	Chronic disease, died, controls, acute disease.
11	121	"	2 & 3	2, 6, 7, 11	Immunized by cult. to filt. virus, control died.
	123	"	2 & 3	2, 6, 7, 11	Chronic disease, died, control died.
12	131	"	3, 4, 5 & 12	21, 3, 6, 2, 6, 4	Immunized to filt. virus, control died.
	134	"	3, 4, 5 & 12	21, 3, 6, 2, 6, 4	Acute disease, died.
	137	"	3, 4, 5 & 6	11, 3, 8, 17, 6, 6	Reaction only from culture—immune to filt. virus.
	138	"	3, 4, 5 & 6	11, 3, 8, 17, 6, 6	Reaction only from culture. Chronic dis., died after exp. to filt. virus.
13	140	"	4, 5, 6, 9, 11	6, 22, 7, 11, 14, 10	Immunized by cult. to filt virus.
	145	"	4, 5, 6, 9, 11	6, 22, 7, 10, 14, 10	Not affected by cult., acute H. C. after exp. to filt. virus.
14	275	"	5	3, 6	Died while being bled. Had reaction and symptoms.
	282	"	5	3, 6	Strong reaction, immune on expos., 2 controls immune.
15	306	Contam.	2	16	Reaction from cult. Control, after exposure during reaction period, took subacute type of disease, and died. Cult. pig developed acute type of disease and died after symptoms appeared in control.

In the foregoing series of inoculations of 27 hogs with cultures of *Sp. hyos,* each of which was controlled by one or more normal pigs, except in the case of numbers 53 and 56, the following summarized results were obtained:

12 hogs, (45.2%) developed disease typical of hog cholera, the cases terminating fatally.

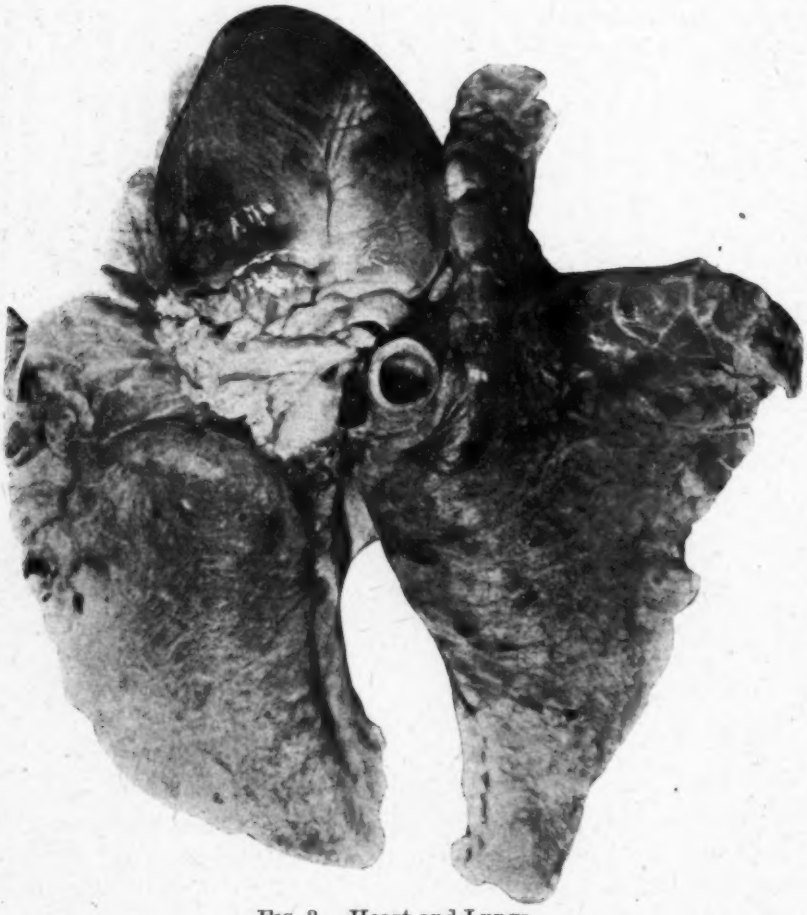

FIG. 3. Heart and Lungs.

7 hogs, (26%) exhibited reactions after which they were injected with the filterable virus and found to be immune to hog cholera. 7 hogs, (26%) were not affected by the injection of cultures of *Sp. hyos,* as shown by absence of immunity on subsequent exposure to the filterable virus.

1 hog, (3.7%), number 275, gave questionable results.

In these experiments nine different culture strains of *Sp. hyos* were used.

It is a well known fact that *Spirochaeta pallida* rapidly loses its virulence when cultivated on artificial culture media.

In the discussion of "Immunity in Syphilis" Zinsser[6] makes the following statement:

"Were it not for the production of lesions with cultures in their early test tube generations by Hoffman, and by Noguchi in a few experiments, one would be almost in doubt as to the identity of the virulent with the culture organisms."

Further study may show that *Sp. hyos* may exhibit the same characteristic.

The results of animal inoculation experiments indicate that *Spirochaeta hyos,* when injected into healthy hogs, in some instances is capable of producing symptoms and lesions similar to those present in hog cholera.

Further experimentation is necessary, however, in order that definite conclusions can be drawn as to the specific etiological relationship of this organism to hog cholera. At the present time the following tentative suggestions are offered:

1. *Sp. hyos* under certain conditions, is pathogenic for swine, producing symptoms and lesions characteristic of hog cholera.

2. *Sp. hyos* may rapidly become attenuated when grown under artificial conditions and therefore may often become incapable of producing disease when injected into healthy hogs.

3. The injections of attenuated cultures into healthy hogs sometimes sensitize the animals and sometimes confer resistance against infection when subsequent inoculations are made with the filterable virus of hog cholera.

4. The results of several inoculation experiments have shown that control hogs confined with the inoculated animals may develop symptoms and lesions similar to those found in hog cholera, while inoculated hogs may remain normal or exhibit reactions only. This may be explained by assuming that the attenuated organisms multiply after injection, and, regaining their virulence in a natural habitat, may cause disease when ingested by the healthy control animals.

SUMMARY OF THE INVESTIGATION OF SPIROCHAETA HYOS. The general trend of results pertaining to this series of investigations justifies a continuation of the study of *Sp. hyos.* Much work re-

mains undone and some of the results which have been reported await the confirmation of other investigators. However, the findings bear some significance and further investigation of this organism is warranted on the part of those interested in the problem of hog cholera, its cause and prevention.

Hog cholera is at present classified etiologically as a disease due to an ultravisible virus. There exists no recognized consensus of opinion regarding the relative importance of the pathological

FIG. 4. Mesenteric Glands.

changes which take place in cases described as hog cholera and present literature on this subject constantly revolves around the query, "What is hog cholera"? The diagnosis rests entirely upon history of outbreak, clinical symptoms, autopsy findings and the results following treatment with serum. Preventive treatment depends upon the use of anti-hog cholera serum, which during the last six years has been manufactured in large quantities and used extensively. The value of anti-hog cholera serum has been abundantly proven, but the general, practical efficacy of the product, in proportion to its cost and certain other disadvantages, has been subjected to serious criticism.

Students of the hog cholera problem must place more concentration upon the study of the filterable virus and the pathology of the disease in order that a logical basis may be established for the successful solution of the problems of accurate diagnosis and practical prevention.

GENERAL CONCLUSIONS FORMED FROM RESULTS OBTAINED THUS FAR. During this series of investigations the following phenomena have been demonstrated:

1. The presence in small numbers, of a spirochete, described as *Sp. hyos,* in the blood of hogs infected with hog cholera, as shown by microscopical studies. In the majority of cases, mass cultures from the blood of animals suffering from hog cholera yield a growth of spirochetes, usually accompanied by *B. coli communis, B. cholerae suis, B. enteritidis,* staphylococci and other organisms.

2. The presence of *Spirochaeta hyos* in the intestinal ulcers, cecal crypts and external local lesions of animals suffering from hog cholera.

3. The successful filtration of *Sp. hyos* from suspensions containing a variety of contaminating microorganisms, as evidenced in one or two instances by growth of the spirochete in pure culture in transfers made from the filtrates, and the production of disease processes similar to hog cholera in hogs inoculated with the filtrates.

4. The production of disease similar to hog cholera, under certain conditions, in normal hogs inoculated with pure cultures of *Sp. hyos* which have passed through several generations on artificial culture media. The presence of sensitization in some instances and, in others, resistance toward subsequent injections of the filterable virus of hog cholera, in hogs which have received pure attenuated cultures of *Sp. hyos.*

5. The specific antigenic power[7] of extracts prepared from pure cultures of *Sp. hyos* when used in complement fixation tests with sera from cholera hogs as compared with the results of similar complement fixation tests with the sera of normal hogs and those suffering from other disease processes.

CONFIRMATORY DATA. Relatively little work has been reported in confirmation of the foregoing conclusions.

Arnheim[8] found spirochetes on dark field preparations made from the peripheral blood of infected hogs, but not from the heart's blood. He could not demonstrate spirochetes in the blood of normal hogs.

Connaway and Durant[9] have found that an experimental antigen prepared from intestinal ulcer material, which is usually rich in spirochetes, gave encouraging results as a specific reagent in experimental complement fixation tests.

This experimental ulcer extract antigen was prepared in such a way that it was "practically free from blood and blood carrying tissue containing any large amount of the circulating 'filterable virus'."

Connaway and Durant also tested a total of 76 experimental spleen extract antigens, 10 per cent of which manifested antigenic

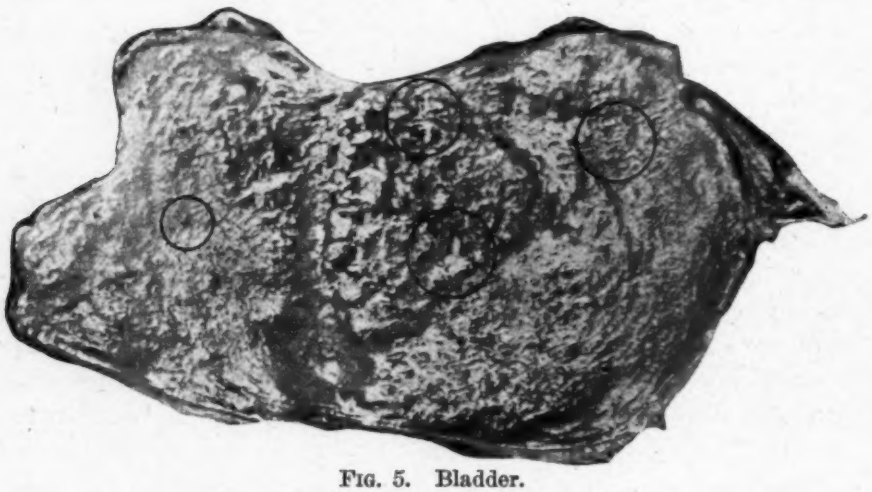

FIG. 5. Bladder.

properties. Experimental antigens prepared from the blood, kidneys and lymph glands yielded negative results.

Rüther[10], Betegh[11], Uhlenhuth and Haendel[12], Arnheim[8] and Dorset[13] report the presence of spirochetes in the intestinal ulcers of infected hogs. Uhlenhuth and Haendel state that spirochetes have been found in the bile of infected hogs.

In former publications[4] and [14], reference has been made to a short article published by Rüther[10] concerning the presence of spirochetes in the intestinal mucosa of cholera infected hogs. In a monograph, "Zur Sichtbarkeit des Schweinepest-erregers", printed by Rüther in 1910, he reported the observation of spirilla in the blood of cholera infected hogs, referred to the passage of these organisms through a filter and suggested the etiological significance of the spirilla in hog cholera. In this monograph the term "spirochaeta" was suggested in one instance as synonymous

with the term "spirilla", but no attempt was made to describe a definite microorganism.

CRITICISMS. Some criticisms have been offered concerning the findings summarized in the foregoing. Such have been expressed, for the greater part, merely as opinions and not as facts based upon actual data.

While Arnheim[8] verified the statement that spirochetes may be demonstrated in the blood and intestinal mucosa of cholera infected animals, he expressed the belief that *Sp. hyos* is a saprophyte. He based this conclusion upon the fact that treatment of hog cholera with salvarsan results negatively and also upon the assertion that spirochetes had not been passed through filters under pressure, at that writing.

FIG. 6. Sick Hogs.

Hayes[15] states that spirochetes could not be demonstrated on the dark field in 12 specimens of blood from cholera infected hogs.

Dorset[16] reports that he was not able to find spirochetes in the blood of infected hogs. He states that spirochetes can be demonstrated readily in the intestinal mucosa not only of infected hogs but also that "an extended examination of the intestinal contents of healthy hogs has shown that the same spirochetes are present there in considerable numbers.

He therefore believes that *Spirochaeta hyos* is a "saprophytic inhabitant of the hog's intestine."

Meyer[17] calls attention to the destructive action of sodium taurocholate, saponin and lecithin on spirochetes, while the filterable hog cholera virus exhibits more resistance to such substances. This fact, according to Meyer, supports the opinion that *Sp. hyos* is not a pathogenic organism.

Referring to the negative evidence which has been advanced the following suggestions may be offered:

1. Failure to find *Sp. hyos* on the dark field in the blood of cholera infected hogs is an admission of lack of perseverance in following up the work. The spirochete may be secured in blood cultures as reported in this paper.

2. Failure to successfully treat cases of hog cholera with arsenical or mercurial preparations should not be considered as evidence that *Sp. hyos* is in no way related to hog cholera. The successful use of salvarsan in the treatment of syphilis is not uniformly accepted, and moreover syphilis is a disease which shows no clinical resemblance to hog cholera and the successful treatment with mercury and salvarsan depends upon continued application of these substances.

3. Claims of failure to pass spirochetes through filters under pressure cannot be maintained at the present time.

Sp. hyos has been passed through the Berkfeld filter[18]. Wolbach and Binger[19] have described a spirochete, named by them *Sp. elusa,* which they passed through a Berkfeld "V" filter. They have also reported the filterability of *Sp. biflexa,* which they found in fresh water.

Todd and Wolbach[20] have shown that *Sp. duttoni* could be forced through a Berkfeld filter with a pressure of 50–90 pounds per sq. inch, while they did not pass through the filter under atmospheric pressure. It is inferred that the organisms which passed through the filter under pressure represented the "granule phase."

4. The demonstration of spirochetes in the intestines of normal hogs, with the assumption that such spirochetes are identical with *Sp. hyos,* does not constitute sufficient evidence upon which to draw negative conclusions regarding this organism.

It is now recognized that *Sp. pallidum* is the specific cause of syphilis in spite of the fact that the oral cavity of the healthy individual is the normal habitat of saprophytic spirochetes. Positive findings of spirochetes in the intestinal mucosa of swine immune to cholera have been reported, but they are found in small numbers and only in rare cases in the intestines of healthy hogs, as compared with the findings in the intestinal ulcers and cecal crypts of infected animals. However, granting that spirochetes may be demonstrated in large numbers in the intestinal canal of healthy hogs, the assumption is not well founded that all microbic

forms of the intestinal flora which resemble spirochetes morphologically, are identical with *Sp. hyos.* With our present meagre knowledge of spirochetes, it is impossible to rely upon microscopical characters alone in distinguishing the known forms. As an illustration it may be stated that the intestinal tract of normal man contains non-pathogenic organisms so closely resembling ***B. typhosus*** microscopically that no differentiation can be made, consequently typhoid fever cannot be diagnosed in the laboratory by a morphological study of the organism.

During the course of this investigation, *Sp. hyos* has been found in large numbers in the intestinal mucosa of a few animals which had been immunized to hog cholera. It can be assumed that the presence of these organisms in the intestine of immune hogs may possibly characterize such animals as "carriers" of the disease.

5. The inference drawn from the data concerning the resistance of the filterable hog cholera virus to the action of sodium taurocholate as compared with that of spirochetes, like some of the foregoing, represents circumstantial rather than direct evidence. Much has been written concerning some of the phenomena attending the life history of *Sp. pallidum* and other spirochetes. While little is known concerning the life cycle of this group of organisms there are many well known authorities, Balfour[21], Fantham[22], Marchoux and Couvey[23], Hindle[24], Dutton and Todd[25], Sergent and Foley[26], Noguchi[27], who have observed the "granule phase." It is altogether possible that at certain stages of development *Sp. hyos* and other organisms of this group may be more resistant to various substances and conditions than during the period represented by the morphological form of the organism with which the worker is familiar.

General Conclusion. While much work remains to be done on *Spirochaeta hyos*, only one important step is necessary to prove with certainty whether or not this organism bears any direct etiological relation to hog cholera. Some means must be developed through which the organism may be isolated in pure culture directly from the infected animal in order that pure cultures, unattenuated by tedious manipulation in an artificial environment, may be utilized in a series of animal inoculation experiments. Under such conditions, uniformly positive results, together with data already in hand, would serve as final, conclusive evidence as to the specific pathogenicity of *Sp. hyos.* Until such experiments can be success-

fully carried out, positive conclusions must be withheld, but, in the meantime, *Sp. hyos*, may be regarded as an organism present in animals infected with hog cholera, possessing certain characters suggestive of its pathogenic nature.

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At the request of farmers and business men in Southeastern Texas, the Bureau of Animal Industry has opened a branch tick eradication office at Houston, Texas, and has placed Dr. J. B. Reidy in charge, with a corps of veterinary inspectors, to conduct the work of tick eradication in that section. The people of this section are especially anxious to have these counties free from ticks as quickly as possible so that their free territory will adjoin the free territory of Louisiana where compulsory state tick eradication promises an early freedom of that state from quarantine. The work of tick eradication now being carried on in Western Texas will be directed as heretofore from headquarters in Fort Worth.

THE COMBINED AND FOLLOW-UP SYSTEMS OF TUBERCULIN TESTING*

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Tuberculin was first reported by Koch in 1890 at the National Congress at Berlin, and introduced into the United States into general use in the nineties. Thus, in general terms, we may say this country has had twenty years of tuberculin testing on a large scale.

During this time, statistics have been gathered from which incomplete conclusions were drawn; state laws have been passed, worked on for a few years and altered or repealed; municipalities have drawn up ordinances which they could not enforce in spite of the fact that the highest courts of the land have declared their regulations constitutional.

One state law was passed, but later repealed, going so far as to prevent the application of the tuberculin test by municipalities as a necessary requisite to ship milk into their borders, and more local and general bitterness of feeling has been engendered in its name than any other veterinary police sanitary measure ever applied in these United States. And yet, today when we look back over our twenty years of effort, we find results that are somewhat disappointing. This is partly due to the fact that the first laws and regulations passed were the result of too much enthusiasm supported by too meager knowledge regarding the limitations of the tuberculin test, so that claims were made which we were not able to fully substantiate.

As a result of the early enthusiasm, laws and regulations were passed which were too drastic, and tended in themselves to create antagonism on the part of live stock owners in general. We permitted the cattlemen to infer that by the use of tuberculin their herds would speedily become free from tuberculosis; and history indicates that many cattlemen whose cooperation was secured at the beginning of the work have, through their disappointments, become so violently opposed to the use of this agent that their claims regarding the failures are greatly exaggerated.

The attitude then held by the profession was not altogether

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surprising since larger claims have been made and more enthusiasm exhibited by ourselves and sister profession over agents that have not been nearly as valuable as tuberculin.

There are many of us who started our professional life feeling that tuberculin was practically a sure method of diagnosis, and had we depended upon the impressions we then had, and not found out its limitations by extensive and in some cases, sad experience, we would still hold that opinion, in spite of the fact that the limitations have been called to our attention, by published articles from men of international reputation.

This opinion is naturally still held by many of those whose experience in tuberculin testing has not been extensive, or limited to herds where the percentage of reactors was low and therefore, have not had an opportunity to have the limitations of tuberculin forced upon them as strongly as those whose experience is extensive, and especially those who are dealing with herds where the percentage of reactors was large.

In spite of our disappointments, we believe that tuberculin is the most allergic diagnostic agent that we have today and without its aid, we would be entirely helpless in our fight against bovine tuberculosis.

To those of us who have used more than one method of diagnosis, it has appeared that a combination of the various tests would reduce the failures considerably. It behooves us in the face of the responsibility entrusted to us as a profession by the livestock industry to leave nothing undone in ferreting out all cases of tuberculosis. We must do all that we can do in a practical way to accomplish this end, and the object of this paper is to briefly call attention to the limitations of the various forms of tuberculin testing, and to point out the value of the combined and follow-up systems.

Statistics as to the accuracy of the tuberculin test have been compiled largely from the percentage of reactors which have been killed and tuberculosis lesions found. This is generally conceded to be high, so that today we recognize that animals which react to the test, will show tuberculosis on post-mortem examination in nearly 100% of the cases. We are justified in considering for all practical purposes that every reacting animal to a properly performed test is tuberculous. In the control of tuberculosis in ordinary herds the harm done by eliminating one or more tuberculosis free

animals is in no way comparable with that occasioned by leaving in the herd a tuberculous cow that has not reacted. The most dangerous animal from the viewpoint of control of tuberculosis is the tuberculous non-reacting cow.

Some will argue that by such drastic means of ascertaining reactors we will eliminate so many cows that we will be at a loss to properly handle them. This has been especially true in some European countries where so many reactors were found that tuberculin testing was discontinued simply because they could not from an economic standpoint, condemn for dairy purposes all reacting animals.

The handling of reacting cattle in communities where tuberculosis is very prevalent is a serious question, but with proper leniency shown, as the gravity of the situation requires, it need not be dreaded, no matter what the percentage. We were able, on account of the broad-mindedness of Dr. L. M. Powers, Health Commissioner of Los Angeles, who has had a life-time experience in public health work, to prove the practicability of the following system of handling reacting animals in a large dairy.

In the latter part of 1913 the University of California and the Los Angeles Health Department began regular tuberculin testing of a herd of 825 head of dairy cattle, which were known to be heavily infected with tuberculosis.

The land occupied by these cattle was divided by a railroad right of way into two distinct ranches. Following the first test, and at each subsequent one made at six months intervals, all reacting animals were kept on one ranch and all healthy animals on the other. Calves from both herds were kept on the healthy ranch, raised on pasteurized milk, tested when large enough to turn out on pasture, and the non-reactors used to replenish the great losses to the healthy herd which the first subsequent tests caused.

This produced a herd which at the time of its greatest numerical strength numbered over 500 head of cattle, all tuberculous, which were under constant observation and the milk from which was allowed to be sold in the city of Los Angeles after it had been pasteurized.

Animals in the reacting herd, as soon as they showed apparent evidence of tuberculosis, were removed, but no special means of ascertaining such cases by ausculation, percussion, or laboratory examination of secretions were resorted to.

By such a system no financial loss was caused to the owner in spite of the fact that 70% of a herd of 825 cattle reacted to the first test. This system worked sufficiently satisfactorily that during the following year another herd of 500 head of animals were brought under the same system, the only difference being that in this case the tuberculous dairy was conducted at a distance of eight miles from the healthy one.

We have had no cause to regret such action on our part from the public health stand-point, since extensive experiments conducted by the writers, and reported in the August number of the *Journal* of this association, show that milk from one of these herds in the raw state, contained living tubercle bacilli, on every examination, but after it had passed through an approved system of pasteurization as conducted on a commercial scale in an ordinary modern city milk plant, it then was entirely innocuous to guinea pigs without a single exception. We are convinced that in a community where tuberculosis is prevalent among livestock, it is no worse to allow the sale of pasteurized milk from known tuberculous cows than to allow the sale of pasteurized milk from untested cattle; and infinitely better than to allow the sale of raw milk from untested cattle, as is being done in innumerable places in this country.

In the two cases cited, this method of handling reactors, which is really a modified Bang system, was easy of accomplishment because the herds were large and the owners controlled two ranches. This same system, however, can be carried out among small dairies by establishing a so-called cummunity herd of reactors, in which all tuberculous animals belonging to several owners will be kept, and the product of which will be pasteurized. There are some difficulties to overcome in establishing this community herd of reactors with several owners, but none which we feel are insurmountable, although at the present time, we have no working example to offer. The same system may be adopted by several pure bred breeders whose herds are in reasonably close proximity to one another.

THE SUBCUTANEOUS TEST. This being the original method of administering tuberculin, naturally the largest amount of data and statistics have been gathered in reference to it.

The Bureau of Animal Industry has gathered valuable statistics on the percentage of reactors in which tuberculous lesions were found. Thus Melvin reported in 1908 that 23,869 reactors

were slaughtered with 98.81% showing tuberculosis. This is generally admitted and, for practical purposes, we may say that all typical reactors are tuberculous.

A careful search of the literature has been made for failures of the subcutaneous test to detect tuberculous animals and little definite data on the point have been obtained. Moreover, it is not of extreme importance to know the exact percentage which failed to react, but the all-important fact that there is a certain percentage of these failures is forced upon us.

Eber gathered all available statistics from 1890 to February 1st, 1892, on the accuracy of the subcutaneous test in which reactors and non-reactors were slaughtered and found that 10.6% of the non-reactors were tuberculous. Lignieres states that from 7 to 8% of tuberculous animals fail to react to the subcutaneous test. In 1906, Carini reports that in the vaccine institute at Bern, where all animals used for the production of vaccine lymph are tuberculin tested, 17.4% of 361 non-reactors were tuberculous. More recent statistics on this include the report of the British Royal Commission on tuberculin testing by Corbett and Griffith.

Their animals were artificially infected with bovine tubercle bacilli and classified as follows:

Class A. 16 animals with severe progressive lesions 31% failed to react.

Class B. 6 animals with general infection, not of the severest type. 100% reacted.

Class C. 61 animals general chronic infection not apparently progressive. 9.8% failed to react.

Class D. 47 animals minimal or local infection. 8.5% failed to react.

Berry of Paterson, New Jersey, reports in 1915 that in the course of five years he found 178 cases which failed to react to the subcutaneous test, but on post-mortem showed lesions of tuberculosis. While the percentage of failures in his report cannot be computed from the information at hand, the number indicates that it is of sufficient extent to give us a realization of the limits of the subcutaneous test.

In our own work, besides the data submitted in tables Nos. 2 and 3, we have recently met with the following unfortunate experience:

In January 1916, a large herd of 350 animals which had been kept under a semi-annual tuberculin test for several years, alternating subcutaneous with the intradermal, with a very low percentage of reactors, was tested by the subcutaneous method, and about 11% of reactors were found—probably resulting from failure of the intradermal test in August 1915, to detect all cases. This necessitated a retest at the expiration of six weeks, which was applied in March 1916. A combined opthalmo and intradermal test was used and 18% of the remaining animals reacted.

While we realize that a good portion of these animals may have been infected after the subcutaneous test was applied in January, we nevertheless are convinced that a considerable number of them constituted failures of the subcutaneous test in January 1916.

INTRADERMAL TEST. This test was originated by Moussu and Mantoux and reported by them in 1908. It has been used and reported in this country by Ward, Baker and Longley of California, Luckey of Missouri, Welch of Montana, and thoroughly described by Haring and Bell of California in 1914.

The available data does not permit us to draw any definite comparisons as to the accuracy of this test with the subcutaneous. Such data would have to be secured by the coordinate testing of large numbers of cattle under identical conditions as to physical condition, previous injections of tuberculin, etc., after which all animals, both reacting and non-reacting were slaughtered and careful post-mortems made.

There are, however, the following data to be considered:

Jewett reports the summary of results furnished by the application of the associated tuberculin tests to 225 animals, viz:

1.	Negative intradermal and negative subcutaneous		189	189
2.	Positive intradermal and positive subcutaneous	9		
	Suspicious intradermal and positive subcutaneous	1		
	(All tuberculous at subsequent post-mortem)		10	10
3.	Positive intradermal and doubtful subcutaneous		10	10
	(All proved tuberculous at subsequent post-mortem)			
4.	Positive intradermal and negative subcutaneous		9	9
	(All proved tuberculous at subsequent post-mortem)			
5.	Negative intradermal and positive subcutaneous	4		
	Negative intradermal and doubtful subcutaneous	1	5	5
	(See note marked * in following table)			
6.	Suspicious intradermal and negative subcutaneous		2	2
	(Not further verified)			

Of the animals tested		225
In 209 cases the two tests were in agreement (but note that in ten of these cases only doubtful subcutaneous tests were obtained against the positive intradermal ones)	209	
The intradermal test scored over the subcutaneous test in nine cases (positive intradermal and negative subcutaneous)	9	
*The subcutaneous test scored over the intradermal test in five cases (but note that in two of these animals no tuberculous lesions were found at subsequent autopsy, and in another only calcified lesions were present, non-infective for guinea pigs). One of the other animals was an advanced clinical case	5	
The two animals gave suspicious intradermal reactions but negative to the subsequent subcutaneous test, and were not further verified	2	
	225	225

This comparison slightly favors the intradermal test. Objection, however, may be made to this comparison on the ground that the subcutaneous test was applied soon after the intradermal.

M'Fadyean and Sheather have not obtained such a favorable impression regarding the intradermal test. These workers tested a number of calves, artificially infected with bovine tubercle bacilli, applying the subcutaneous, intradermal and conjunctival tests simultaneously. One explanation for the rather low percentage of reactors to the intradermal test obtained by these workers is found in the fact that in all but a few instances, readings were not made later than 27 hours after the injection. The readings of the intradermal reactions, according to Haring, should be made at the 36th and 72nd hours; if only one reading is made, it should occur on the 72nd hour. The advisability of this procedure is supported by a great many field observations. In the intradermal tuberculin testing of certified herds around the Bay Region of California this procedure is followed and Roadhouse, who supervises that work reports that he finds a number of animals that fail to show reactions on the first observation, but, on the 72nd hour, show definite reactions.

In a test recently performed under his supervision fifteen definite reactors were picked, in a herd of 325 animals, on the 36th hour, and on the 72nd hour, eleven more definite reactions were recorded. Such a large percentage of animals to react in that manner is unusual, but the readings in both instances were made by careful and experienced observers.

With this test, as with the subcutaneous test, we believe that for all practical purposes a definite reaction is an indication of the presence of tuberculosis.

Thus, Luckey reports in 1915: "To date we have slaughtered 351 head of cattle which reacted to the intradermal test during 1914. Of these 94% showed lesions. We have good excuses which we might offer for 17 out of the 20 errors. As 94% was satisfactory I do not consider it worth while to bother with offering excuses.

Haring found that of 73 reacting cattle 69, or 94.5% showed lesions and that of 129 non-reacting animals 6, or 4.7% were tuberculous.

Dell of Los Angeles verbally reported a recent test, with the intradermal method, of 38 head of cattle not previously tested. In 35 of these animals he obtained definite, positive reactions. Granting the three non-reactors were tuberculous, the intradermal test was accurate in 92% of the cases.

From our work we have the following to submit regarding the efficiency of the intradermal test in detecting tuberculous animals. The owner of the large herd mentioned above thinking that many of his animals in the tuberculous dairy were healthy, insisted on a retest of the herd. In October 1915, 400 head of these animals were tested, of which all but fifty reacted. Only one reading was made at the 72nd hour. Following this in February of the present year the smaller tuberculous herd numbering 145 animals was retested and thirteen failed to react at one reading on the 72nd hour.

Thus, with a total of 545 animals we failed to get reactions in 63 and granting all these were tuberculous the test was accurate in 88.5% of the cases.

The intrapalpebral test reported by Moussou, Norgaard, Mohler and Eichhorn, is simply an intradermal injection made in the lower eyelid instead of the subcaudal fold. Various portions of the skin have been used for this test. The skin on the neck has been extensively used by Europeans. In hogs, the usual and most desirable point of injection is the base of the ear, but we have given the intradermal test at the base of the heels, and hogs would go lame as a result of a reaction. In fact the tuberculin may give a reaction when injected into the skin on any part of the body. We believe the eye location, while easy to administer, is less practicable than the subcaudal location, because it requires additional help and is often seriously objected to by the dairymen on account of the disturbance caused by working on the heads of the cattle. It is much more difficult to apply to range cattle. While yielding

good recognizable swellings in most of the reactors, the reactions are not always distinctly visible and not uncommonly require actual palpation and comparison with the uninjected eyelid. In cattle where the reaction is not visible nor firm on palpation, it will be difficult to detect a difference between the injected and uninjected eyelid. In some adult cattle there is a normal puffiness present in the lower lid which makes this comparison difficult.

INTRADERMAL INJECTION, SUBCAUDAL AND INTRAPALPEBRAL.
20 EIGHT-MONTH-OLD CALVES, ALL TUBERCULOUS

	Forty-eight hours.		Seventy-two hours.	
	Subcaudal	Intrapalpebral	Subcaudal	Intrapalpebral
1	Walnut	Visible	Walnut	Visible
2	Egg	Distinctly visible	Egg	Same
3	Walnut	Distinctly visible	Walnut, large	Same
4	½ x 2	Just visible	2 almonds	Visible
5	Egg	Distinctly visible	Walnut, big	Same
6	Walnut	Distinctly visible	Almond, diffuse, 2x1	Distinctly visible
7	Large egg	Very distinctly visible	Large egg	Same
8	½ egg	Very distinctly visible	½ egg	Same
9	Walnut	Distinctly visible	½ egg	Visible
10	Egg	Distinctly visible	Same	Visible
11	½ egg	Distinctly visible	Walnut	Same
12	½ egg	Distinctly visible	Walnut	Barely visible
13	Almond	Visible	Almond, diffuse	Visible
14	Almond	Had to be felt	Hazelnut	Had to be felt
15	Pea, diffuse, 1 x ½	Visible	Pea, diffuse, 1½x½	Visible
16	2 Almonds	Had to be felt, large pea	Almond	Had to felt, small (?)*
17	Walnut	Barely visible	2 almonds	Barely visible
18	Egg	Distinctly visible	Egg	Same
19	Thickening 2	Pea, felt	Pea size, diffuse	Had to be felt, pea
20	½ egg	Barely visible	2 almonds	Barely visible
Above animals injected August 1, 1916, 2 to 3 P. M.			Used .1 c.c. 5% sol. of pp. tuberculin.	

These calves gave positive reactions to the intradermal (subcaudal) test in the early part of June, 1916.

THE OPHTHALMIC TEST. This mode of applying tuberculin received considerable attention, when first introduced by Wolf-Eissner and Calmette in human medicine and by Vallee in the control of bovine tuberculosis. Vallee was the first to recognize the fact that repeated instillations of tuberculin into the same eye do not cause it to become insensitive to tuberculin, but on the contrary such procedure would bring forth stronger reactions in animals re-

acting to the first instillation and positive reactions in animals that failed to show on the first instillation. Non-tuberculous animals, he noted, were not affected by repeated instillations of tuberculin.

Foth, Opalka, Jowett, Reinecke, McCampbell and White, M'Fadyean and Sheather, Bergman and others have reported on this test. None of the above, excepting Opalka and Bergman decided that this test is better or even equal to the intradermal or subcutaneous test. Reinecke obtained very poor results with this test but his conclusions were based on tests performed on but 25 animals, and we can easily understand how one might be inclined to reach such an opinion when only a small number of animals were tested, especially when a single instillation of tuberculin was made.

In the tests recorded in our tables, the single ophthalmo yielded 26.1% reactions in 172 animals at twenty-four hour observations and 36.5% in 85 animals in one twelve and one twenty-four-hour observation.

The secondary ophthalmo yielded 47.8% reactions in 115 animals while sensitized ophthalmo test gave 77.2% reactions in 57 animals. Our percentage of correct diagnosis would have been higher had we included as reactors, manifestations, which no doubt would have been considered reactors by some.

About 1350 animals were tested by the writers and members of the Division of Veterinary Science of the University of California, using the sensitized ophthalmic test, combined with or followed immediately by the intradermal or subcutaneous method. The ophthalmic test yielded about 72% reactors among the intradermal and subcutaneous reactors. If, however, we had limited our observations to a particular test made upon 247 animals, from which we selected but nine reactors, and upon intradermal test nineteen reactors were found, we would have unfairly concluded that the ophthalmic test is less than 50% accurate.

We do not believe that this test can replace either the subcutaneous or the intradermal test in routine work. It nevertheless, has a place in the control of bovine tuberculosis. It is of value where other tests are not applicable, but its principal value is in combination with other tests and as such it has been recommended and used by Vallee, Lignieres, Richter, Morel, Jugeat, one of the writers (Traum) and others.

From the facts briefly enumerated above, it is observed that none of the three methods of applying tuberculin can be depended upon to detect all cases of tuberculosis, especially where the percentage of infected animals is high and it is only natural that a combination of two or more of these tests should appeal to us. Lignieres went so far as to use his influence with the Minister of Agriculture of Argentine to issue a decree requiring that all animals at the Quarantine Station at Buenos Aires be tested with the ophthalmic and subcutaneous tests. With this combined method failures were very rare and the percentage of tuberculous animals stopped was multiplied by 3. The result also proves the enormous value of associated reactions in diagnosing tuberculosis.

Various combinations have been suggested and used by these men and in practically all of them the ophthalmic test is included. Lignieres recommends the ophthalmic followed by a subcutaneous injection of tuberculin; first, however, giving a small amount of the tuberculin in the derm before injecting beneath the skin. Littlejohn, Morel and Jugeat took advantage of the observations of Guerin, who noted that by following the ophthalmic test with ordinary subcutaneous injection, the latter often had the effect of reviving and intensifying the manifestations of the eye reaction. Littlejohn tested 64 head of cattle, 26 of which reacted to the subcutaneous test performed seven days after the ophthalmic test, and all 26 gave a secondary conjunctival reaction, whereas only sixteen gave a reaction to the first instillation. One animal gave an eye reaction both before and after the subcutaneous injection which failed to give a thermal reaction.

Jugeat and Morel also report very good results with this combination and all three of these observers claim that the single ophthalmic has limited value. On the contrary, our work recorded in tables 2 and 3 does not permit us to agree with these findings regarding secondary reactions. Jowett also failed to get such a large number of secondary ophthalmic reactions.

While we have used in a large number of animals a combination of ophthalmic and intradermal, or ophthalmic and subcutaneous, the information obtained from these tests was of such a nature that we could not draw definite conclusions therefrom. We, however, fully realized the advantage of combination tests. But in order to obtain information from which we could draw more definite knowledge we instituted the following series of combination tests, in

the larger tuberculous herd above described. Six strings of cows were used, totaling 176 animals. All of these animals were given a sensitizing instillation in the left eye, of concentrated tuberculin. The tuberculin was thrown upon the eyeball from a one c.c. glass syringe, from which the needle shank had been removed. No holding of the animal's head or assistance of any kind was required. The ease of this means of administration strongly recommends it, and the fact that we obtained as good a percentage of reactions as is usually obtained from this test shows the efficiency of this technic. A similar technic was used previously in another herd of 373 animals with equally good results. In strings one and two the first instillation was followed by a second instillation into the same eye three days later and at the same time the left subcaudal fold was injected intradermally with 1/10 c.c. of a 5% solution of precipitated tuberculin.

String three was injected in the subcaudal fold with 1/5 c.c. of a 10% solution of precipitated tuberculin four days after the eye instillation. String four was divided, part being injected in the subcaudal fold with 1/5 c.c. of a 5% solution of ppt. tuberculin and the remainder with 1/10 c.c. of a 5% solution of ppt. tuberculin, three days after the eye instillation. Two temperatures of these animals were taken before the injection and five afterwards in the same manner as is done in an ordinary subcutaneous test.

Strings five and six were given the regular subcutaneous injection in front of the left shoulder, using 2 c.c. of 12½% solution of concentrated tuberculin, four days after the eye instillation. The tuberculin used in all these tests was prepared at the University of California and all was made from the same batch of concentrated tuberculin. The precipitated tuberculin was obtained from the concentrated, 45 c.c. yielding 3.57 grams, thus making it approximately 12½ times as strong. Thus the 1/5 c.c. of a 10% solution of ppt. tuberculin, injected intradermally into string three, was of the same strength as 2 c.c. of 12½% concentrated tuberculin used in our subcutaneous test of strings five and six.

Discussion of the Tables. Tables I, II and III, showing the results of the work were prepared with a view of placing before you our findings in as tangible a form as possible. The subcutaneous, intradermal, ophthalmo, or in fact any form of tuberculin testing will in some cases, bring forth results that are difficult to interpret. In this work the diagnosis on the intradermal and oph-

thalimc tests were made in the field and no animal was recorded as positive to either of these two tests which was not a definite reactor.

Questionable reactors were recorded as negative. We appreciated the fact that, in estimating the value of any test, clearly positive reactions alone are of value. In the control of bovine tuberculosis, however, questionable reactors should be treated as infected until proved to be otherwise. In our diagnosis column to the thermal reaction we have included several questionable reactors, but, with the temperature records before you, you can place these as you may see fit.

Table 1: With a combination of sensitized ophthalmo and intradermal tuberculin tests on 59 tuberculous animals, we obtained distinctly positive results in all but two cases. Cow No. 19 gave a slight reaction to the ophthalmic test, but in our estimation it was not sufficient to be considered as definitely positive. The table is self-explanatory. It might well be stated here that in String No. 1 (animals 1 to 29) there were animals with visible indications of the disease which were to be removed from the herd on account of the advanced stage of the disease. Cows 6, 15, 23, 25 and 28 were advanced cases of tuberculosis. The general condition of cases 14 and 19, the non-reactors, was found to be good.

The negative intradermal reactors recorded in this table were examined on the 96th hour and at that time all were still negative.

A study of our next table leads us to believe that had temperatures been taken following the intradermal injection of tuberculin, even better results would have been obtained, since we find that three cows that failed to give positive local reactions gave thermal reactions.

Table II: The combination used upon animals recorded in this table consisted of an instillation of tuberculin into the eye, followed by an intradermal injection four days after the eye instillation in cases 60 to 88 inclusive and 3 days after in cases 89 to 118 inclusive. With this combination we were bringing into play a local, a thermal, an ophthalmic and a secondary ophthalmic reaction. Haring pointed out, contrary to the findings of Moussu and Mantoux, that he was able to obtain a thermal reaction as a result of the intradermal injection. In six herds, numbering 273 cattle reported by him, he found 153 cattle that reacted locally, 130 that reacted thermally, 25 that reacted locally, but not thermally, and two that reacted thermally but not locally. In his tests he used

Table № 1

Intradermal And Sensitized Ophthalmo
59 Animals All Tuberculous

Injected ⅟₁₀ c.c. of 5% ppt. tuberculin in Subcaudalfold 3-VIII-16. Ophthalmo Instilled ⅟₁₀ c.c. Concentrated O.T.

№ of Animal	24 Hour Observation	48 Hour Observation	72 Hour Observation	Diagnosis	1st Inst. 31-VIII-16 Observation 12 Hours	1st Inst. 31-VIII-16 Observation 24 Hours	2nd Installation 5-IX-16 - 4.30 P.M. Observ. 24 H	Observ. 5 A.M.	Observ. 9 A.M.	Observ. 5 P.M.	Diagnosis	Positive Both	Positive One Negative Other	Negative to Both
1	Diff. 3'x 1½'	Diff. 3'x 2'	Thickened x	+			S.C.O.L	Same	Same		+	+		
2	2 Eggs	2 Eggs	2 Eggs	+			M.C.O.L	V.S.C.O.L	Same	Bead	+	+		
3	Egg	Egg	Large Walnut	+			S.C.O.L	Same	Same		+	+		
4	2 Almonds	Egg	Egg	+			B.F.L	S.C.O.L	V.S.W.T.L	M.C.O.L & D	+	+		
5	Hazelnut Diff.	2 Almonds	Hazelnut	+			Bead B.C.	Dried	Negative		−		+ I, − O	
6	2 Almonds Diff.	2 Almonds Diff.	Almond Diff.	+			S.B.F.L	Same	Dried		+	+		
7	½ Egg	Egg	Walnut	+			M.B.C.O.L	S.C.O.L	Same	Bead C.O	+	+		
8	Almond Diff.	Walnut	3 Almonds	+			Negative	Negative	Negative		−		+ I, − O	
9	2 Almonds	Large Walnut	Large Walnut	+	−	+	V.S.C.O.L	Same	Same	Decreased	+	+		
10	Hazelnut Diff.	Walnut	Walnut	+			S.C.O.L	Same	Dried	S.L.B.T.	+	+		
11	2 Almonds Diff.	Thickening 2x	2 Almonds	+			Sl. B.T.	Negative	Negative		−		+ I, − O	
12	Negative	Thickening 2x &	Thickening 3x	+	−	+	V.S.C.O.L	Same	Same	Same	+	+		
13	Sl Thickening	Walnut	2 Almonds	+			M.C.O.L	Same	S.W.O.	B.T. & Dried	+	+		
14	" "	Sl Thickening	Sl Thickening	−			Negative	L	Negative		−			−
15	2 Almonds Diff.	Large Walnut	Egg	+	−	+	S.C.O.L	Same	S.C.O.L	S.B.F.L	+	+		
16	Walnut	Almond	Large Pea Diff.	+			M.C.O.L	Drying	ace F.		+	+		
17	Egg Diff.	½ Walnut Diff.	½ Egg	+	−	+	S.C.O.L	Same	S.W.T.F.	Bead & L	+	+		
18	Sl Thickening	Small Almond	Hazelnut	+			M.C.O.L	S.C.O.L	Same	Decreased	+	+		
19	" "	Very Light Thick	Same	−			L	L	Sl.W.F.L		−			−
20	One Almond	Thickening 2x	Walnut	+			M.B.T.	Negative	S.B.T.		−		+ I, − O	
21	Sl Thickening	" "	2 Almonds Diff.	+			V.Sl. dirty T	Negative	Negative		−		+ I, − O	
22	" "	Almond	2 Almonds	+			Not tested on account of condition of eyes							
23	2 Eggs Diff.	2 Eggs Diff.	2 Eggs Diff.	+	+	+	M.B.F.L	Same	M.W.O.	M.Gum F.T.O	+	+		
24	Sl Thickening	Thickening 2x	2 Peanuts	+			Sl.C.O.	Sl.C.O.	Negative		−		+ I, − O	
25	Negative	Negative	Walnut	+			M.C.B.O.L	S.C.O.L	Same	M.B.F.L	+	+		
26	2 Almonds	Not examined	Almond	+	+	+	S.C.O.L	Same	Same		+	+		
27	Egg	3 Eggs	Orange	+	−	+	M.B.T.	M.C.O.T.L	S.Y.O.L	M.B.F.L	+	+		
28	Walnut	Walnut	Hazelnut Diff.	+	+	+	M.C.O.L	Less Dry	Dry		+	+		
29	Egg Diff.	Thickening 2x &	Thickening 2x	+	+	−	M.C.B.O.L	Dried	Dried		+	+		
30	Thickening 2x	2 Almonds	Walnut	+			M.B.F.L	Same	S.Y.O.		+	+		
31	Almond	Thickening 2x	Almond	+			Sl.C.O.L	M.C.O.L	Dried		+	+		
32	2 Almonds	½ Egg	Walnut	+	−	+	V.S.C.O.L	Same	Same		+	+		
33	Almond	Almond	Large Pea	+			Sl.B.L	Bead B.L	Negative		−		+ I, − O	
34	Sl Thickening	Sl Thickening	Negative	−			M.B.F.L	Same	Same		+		− I, + O	
35	2 Almonds	Thickening 2x	3 Almonds	+			L	Sl.B.T.	Negative	S.B.T.L	−		+ I, − O	
36	2 Eggs	2 Eggs	2 Eggs	+	−	+	V.S.C.O.L	Same	Negative	Same	+	+		
37	Thickening	Thickening 2x	Thickening 2x	+			S.C.O.L	Decreased	Dried		+	+		
38	2 Almonds	Small Egg	" 4x	+			V.S.C.O.L	Same	Same		+	+		
39	Almond Diff.	3 Almonds	Walnut	+	−	+	M.B.C.L	Same	M.T.L Dried		+	+		
40	Thickening	2 Almonds	Negative	+			Sl.B & C. W	B.C.B.T.	Dried		+	+		
41	Walnut	3 Almonds	Not examined	+			Sl.B & T	Negative	Negative		−		+ I, − O	
42	½ Egg	Large Egg	1 Orange	+	−	+	S.C.O.L	Same	L		+	+		
43	Walnut Diff.	2 Almonds	2 Almonds	+			Negative	L	Sl.C.O.F.		+	+		
44	Almond	Egg	Hazelnut Diff.	+	+	−	S.B.F.L	Same	S.C.Y.O.L	M.B.F.L	+	+		
45	Walnut Diff.	3 Almonds	Same	+	+	+	S.C.O.L	S.C.O.L	Less	Sl.B.F.	+	+		
46	2 Almonds	Walnut	Same	+	+	−	S.C.O.L	Same	L		+	+		
47	" "	2 Almonds	Same	+			S.C.O.L	"	Dried		+	+		
48	Walnut	½ Egg	1 Almond	+			L	Negative	Negative		−		+ I, − O	
49	Almond 12x &	2 Almonds	Walnut	+			Not tested on account of condition of eyes							
50	Walnut	Egg	Orange	+			V.S.C.O.L	Same	Same	M.Y.O.L	+	+		
51	½ Egg	Egg	½ Egg	+			Sl.B.C.T.O.L	Same	Same	M.C.O.L	+	+		
52	Negative	2 Almonds	Sl Thickening	+			Negative	Sl.B.T.	Negative		−		+ I, − O	
53	2 Almonds Diff.	3 "	Hazelnut	+	−	+	Sl.C.O.L	S.C.O.L	Same		+	+		
54	2 "	Thickening 2x	Sl Thickening	+	+	−	Sl.C.O.L	Negative	Negative		+	+		
55	Thickening 2x	Walnut	Walnut	+			M.C.O.L	Decreased	Dried		+	+		
56	" "	Flat Thin Pelt	Negative	−	+	+	V.S.C.O.L	Same	Same		+		− I, + O	
57	2 Eggs	2 Eggs	2 Eggs	+	+	−	M.B.F. & V.Sl.	S.C.O.L.	Same		+	+		
58	2 Almonds	½ Egg	Walnut	+			V.S.C.O.L	Same	Same	Bead Slimy M	+	+		
59	Walnut	Walnut	Almond	+			M.C.O.L	Same	S.C.O.L	Sl. B.F.	+	+		

Key to letters describing ophthalmo reaction

Extent - Sl. = Slight
M = Medium
S = Strong
V.S. = Very Slight

Character - C = Cream
Y = Yellow
W = White
B = Blue
G = Green
T = Translucent
O = Opaque
F = Flakes
L = Lacrymation

Table № 2

Intradermal Injection Thermal ~ Local Reactions & Secondary Ophthalmo Reactions

59 Animals · All Tuberculous

№ of Animal	24 Hours	48 Hours	72 Hours	Diagnosis	Temperatures Before Injection 24 Hrs	48 Hrs	72 Hrs	After Injection 24 Hours	48 Hours	72 Hours	Diagnosis	Ophthalmo installation 18 Hours	24 Hours	Ophthalmo Secondary Reactions					Diagnosis	Nº 2 Positive	Positive to one or more	All 3 Negative
60	Walnut	2 Almonds	Thickening 2x	+	2.0	2.2	4.3	5.4	4.0	1.7	1.4	+							–		+ I + T - O	
61	2 Almonds	I -	Almond	+	3.0	2.4	4.1	2.8	1.8	1.0	0.4	+							–		+ I + T - O	
62	Walnut	Hazelnut	Hazelnut	+	1.8	1.8	1.3	1.8	1.7	1.4	1.4	–							–		+ I - T - O	
63	3 Almonds	Walnut	Almond	+	2.6	1.2	1.3	2.0	1.8	2.3	1.3	–							–		+ I - T - O	
64	Walnut	Almond	-	+	2.0	1.8	2.6	1.4	1.5	1.3	1.6	–							–		+ I - T - O	
65	3 Almonds	Thickening 2x	Walnut	+	3.0	0.6	6.0	6.3	4.7	4.1	2.6	+				M.C.O.L	M.C.O.L		+	+		
66	- -	2 Almonds	-	+	2.9	2.4	4.0	4.6	4.8	2.1	1.3	+						Bead	–		+ I + T - O	
67	- -	2 -	2 Almonds	+	2.4	2.2	3.0	4.1	3.3	2.4	2.0	+	+	+		M.B.P.L	S.B.P.L		+	+		
68	½ Egg	Thickening 2x	Thickening 2x	+	1.4	1.8	2.5	4.1	2.5		1.4	+			S.B.P.L	Same	Same	Bead & L	S.L.P	+	+		
69	Thickening 2x	- -	- -	+	2.6	2.0	2.5	3.9	4.7	3.6	2.4	+	–	+		M.B.P.L		L	Bead	+	+		
70	Egg Dill	Egg	½ Egg	+	2.0	1.8	4.4	5.8	4.7	3.0	2.7	+	–	+		S.C.O.L		L	Bead	+	+		
71	2 Almonds	Hazelnut	Hazelnut	+	2.0	2.0	2.3	4.1	2.0	1.8	0.7	+	–	+		S.B.T.L	S.B.P.L	M.C.O.L	S.L.P	+	+		
72	Thickening 2x	2 Almonds	Thickening 2x	+	1.0	0.6	1.5	1.2	1.3	1.3	0.7	–						L		–		+ I - T - O	
73	Walnut Form	- -	½ Egg	+	1.6	1.6	2.3	3.0	4.3	2.3	1.4	+	+	–	S.B.T	M.C.O.L	Same	Same	V.S.	+	+		
74	½ Egg Dill	½ Egg	Thickening 2x	+	1.4	2.2	1.0	3.3	4.4	2.4	1.0	+				M.B.P.C.O.L	S.M.B.P.C.O.L	M.C.O.L	S.L.B.P.	+	+		
75	2 Almonds	Almond	Almond	+	1.8	1.4	2.3	1.2	2.0	2.4	2.3	+	+	+	V.S.C.O.L	Same	Same	Same	Very Slight	+	+		
76	½ Egg	Hazelnut	Hazelnut	+	1.6	2.8	2.6	2.0	2.3	2.7	1.6	?							–		+ I ? T - O	
77	- -	Thickening 2x	Thickening 2x	+	2.4	2.5	3.4	2.3	4.7	2.2	1.8	+	–	+		L	L	Bead		–	+		
78	Sl Thickening	- -	2 Almonds	+	2.4	2.1	3.2	2.3	4.0	2.6	1.2	+							–		+ I + T - O	
79	Thickening 2x	Sl Thickening	Sl Thickening	–	2.2	1.8	2.1	2.2	2.0	2.0	0.8	+							–		- I + T - O	
80	Egg	Walnut	Walnut	+	1.6	1.7	3.0	4.0	3.4	2.9	1.8	+	+	+	V.S.C.O.L	Same	Same	Same	Same	+	+		
81	2 Eggs	Orange	Orange	+	2.0	2.6	4.7	3.4	3.8	4.3	3.9	+	–	+	V.S.C.O.L	-	-	Dried		+	+		
82	2 Almonds	Almond	Almond	+	2.4	2.8	2.3	2.3	4.6	3.9	2.4	?						Sl F.		–		+ I ? T - O	
83	Thickening 2x	Hazelnut	Thickening 2x	+	2.2	1.3	2.4	3.2	1.8	1.4	1.0	+	–	+	V.S.C.O.L	Same	Same	Same	W.F.L.	+	+		
84	- 3x	-	- -	+	2.2	2.4	4.2	4.4	3.8	2.4	1.2	+	+	–	S.C.O.L	-	S.C.O.L	M.O.L	B.F.L.	+	+		
85	2 Almonds	Pea Dill	Pea Dill	+	1.2	1.9	2.8	3.3	2.5	1.3	1.0	?							–		+ I ? T - O	
86	Thickening 2x	Egg	2 Eggs	+	1.6	2.0	4.4	3.3	2.0	2.0	1.0	+				M.B.C.T.O.L	M.C.O.L	Same	Sl B.F		+	+		
87	- 3x	Walnut	Walnut	+	2.0	1.7	4.2	3.6	2.6	1.1	0.7	+										+ I + T - O	
88	½ Egg	Thickening 2x	½ Egg	+	1.6	1.8	2.3	2.8	2.0	2.0	1.2	–				Red injected membrane of condition of eyes						+ I - T	
89	- -	Walnut	Walnut	+	2.6	2.0	2.2	2.4	2.2	4.8	2.0	+										+ I + T - O	
90	2 Almonds	Pea	Small Pea	–	2.4	2.2	4.2	4.0	2.4	4.8	4.8	+			S.C.O.L	L	Bead			+		+ I + T - O	
91	Sl Thickening	Negative	Negative	–	0.8	1.8	2.2	2.4	1.7	2.2	1.8	–								–		- I + T - O	
92	3 Almonds	Hazelnut	Walnut	+	2.2	2.1	3.0	4.1	4.7	4.2	4.2	+		+	M.B.P.L	-				+	+		
93	2 -	Pea	Pea Small	–	1.8	2.0	2.1	4.1	3.6	2.4	1.6	+				L				–			
94	2 Eggs	2 Eggs	½ Egg	+	1.8	2.3	4.0	6.2	4.0	3.3	1.7	+		+	V.S.B.F.L	More C	B.T.F.L	Sl	S.T.C.B	+	+		
95	3 Almonds	3 Almonds	3 Almonds	+	1.6	1.6	2.0	1.7	1.3	2.4	1.6	–				-	L			–		+ I - T - O	
96	3 Almonds	Walnut	Walnut	+	1.4	1.0	4.2	4.9	3.4	4.0	4.1	+		+	M.C.O.L	S.C.O.L	Same	Same	Same	+	+		
97	Walnut	2 Almonds	2 Almonds	+	2.0	1.2	2.3	2.2	1.6	1.7	1.3	–			S.C.O.					–		+ I - T - O	
98	2 Almonds	Hazelnut	Sl Thickening	+	2.2	2.0	1.5	1.8	1.3	2.6	1.6	–								–		+ I ? T - O	
99	Almond	Almond	Large Pea	+	2.2	2.3	4.2	2.5	1.3	1.4	1.6	?								–		+ I + T - O	
100	2 Almonds	Walnut	Walnut	+	1.6	1.8	4.2	4.3	4.0	4.9	4.6	+								–			
101	½ Egg Dill	Egg	-	+	2.2	1.6	3.2	4.0	4.2	4.8	3.8	+		+	S.I.G.B.T.L	S.I.B.F.L	Same			+	+		
102	½ Egg	Pea	Almond	+	2.2	2.1	4.5	4.1	4.3	4.2	4.5	+								–		+ I + T - O	
103	- -	2 Almonds	2 -	+	2.2	2.0	4.4	4.6	2.0	1.5	1.2	+								–		+ I + T - O	
104	Pt of injection	Hazelnut	Hazelnut	+	2.2	2.1	2.4	2.1	2.2	2.0	1.1	+								–		+ I + T - O	
105	½ Egg	Walnut	Walnut	+	1.6	2.0	2.3	2.3	1.6	1.7	1.6	–				S.I.B.				–		+ I - T - O	
106	Negative	-	-	+	2.0	2.0	2.1	4.4	2.6	2.8	1.8	+				S.I.B.T				–		+ I + T - O	
107	½ Egg	½ Egg	Thickening 2x	+	2.0	2.0	4.0	4.5	3.1	2.0	1.8	+								–		+ I + T - O	
108	3 Almonds	Almond	-	+	1.2	1.8	4.5	3.3	4.8	2.1	0.8	+			S.I.B.L					–		+ I + T - O	
109	2 Eggs	2 Eggs	2 Eggs	+	1.8	2.0	4.4	4.8	4.7	4.4	2.0	+								–			
110	2 Almonds	Almond	Almond	+	2.0	1.8	3.2	4.0	2.7	2.7	1.4	+		+	M.B.T.P.L	M.B.C.O	N.B.P.L	V.S.C		+	+		
111	Egg	2 -	Thickening 2x	+	1.8	2.0	2.5	3.5	4.0	4.4	3.0	+			M.B.T.O.L	M.C.O.L			S.I.B.C	+	+		
112	Thickening 2x	Almond	Almond	+	1.4	1.8	4.3	2.4	2.0	1.4	0.8	+								–		+ I + T - O	
113	½ Egg	Egg	Egg	+	1.4	2.2	4.0	4.7	4.5	4.4	2.2	+								–		+ I + T - O	
114	2 Eggs	Orange	Orange	+	1.8	2.4	4.8	3.0	4.8	4.4	4.2	+		+	V.S.C.O.L	Same	V.S.C.O.L	Same after injection	Same	+	+		
115	½ Egg	½ Egg	Thickening 2x	+	2.0	1.8	2.3	2.3	2.8	2.7	1.4	–								–		+ I - T - O	
116	Nat Red	Almond	Almond	+	1.0	1.3	4.9	4.6	5.1	3.0	1.4	+								–		+ I + T - O	
117	3 Almonds	Hazelnut	Walnut	+	1.8	1.1	4.4	4.2	4.3	2.8	1.4	+								–		+ I + T - O	
118	½ Egg	-	Almond	+	2.2	1.6	2.4	2.1	4.7	3.7	2.3	+		+	V.S.B.C.F.L	S.C.O.L	Dried	Scab B.F.L	S.I.B.F.L	+	+		

Inoculated ½ c.c. concentrated tuberculin (O.T.) left eye № 60 to 88 and № 1 - VIII - 14

" " " " " " " " " 89 to 118 " 1 - VIII - 14

Injected 5% ½ c.c. 10% Solution ppd tuberculin into left subscapular fold № 60 to 88 inclusive 4 - VIII - 14 4:30 P.M.

" ½c " 5% " " " " " " " " 89 to 118 " " " "

Table № 3 SUBCUTANEOUS INJECTIONS THERMAL AND LOCAL REACTIONS & SECONDARY OPHTHALMIC REACTIONS

58 ANIMALS ALL TUBERCULOUS

No of Animal	Temperature Before Injection 1 PM	Temperature After Injection 4 PM	5 PM	6 PM	7 PM	8 PM	9 AM	10 AM	11 AM	12 M	1 PM	2 PM	Diagnosis	Ophthalmo instillation 24 hr Observ'n	Ophthalmo Secondary Reactions				Diagnosis	Local subcutaneous 48 hr Observ'n	All 3 Positive	Positive to one or more	All 3 Negative
119	14	12	06	00	02	10	28	26					-			S I Y Bead			-				-
120	16	12	64	62	44	24	26	10					+		S B C O L	S Y O F	Drying		+			+T+O-LS	
121	30	16	22	26	44	50	56	46					+						-			+T-O-LS	
122	18	17	10	16	10	10	20	16					-			S I B T L			-	+		-T-O+LS	
123	10	10	43	54	54	40	26	18					+						-			+T-O-LS	
124	20	18	34	43	60	56	52	44					+	+	S B F L	S W O L	Same	Same	+			+T+O-LS	
125	20	18	26	38	54	62	64	36					+						-			+T-O-LS	
126	24	23	28	24	20	10	16	12					-		Not injected - on account of swollen eye								
127	10	16	30	36	54	58	60	40					+		L				-	+		+T-O+LS	
128	16	16	13	19	28	28	42	38					-		L				-				-
129	20	18	35	56	48	40	58	42					+						-			+T-O-LS	
130	14	13	998	04	04	10	12	10					-						-				-
131	22	16	18	13	14	16	10	10					-						-				-
132	10	14	34	26	20	28	34	22					+		S I C F L	S I C O L	S I C O L		+			+T+O-LS	
133	20	16	20	26	38	44	54	44					+						-			+T-O-LS	
134	16	16	51	65	66	54	58	38					+	+					+	+	+		
135	18	25	06	05	08	08	16	12					-			W Bead			-				-
136	20	12	31	50	52	28	26	10					+						-			+T-O-LS	
137	18	18	68	64	50	30	28	20					+	+	V S C O L	V S C O L	Drying	Same	+	+	+		
138	18	16	16	11	14	10	20	10					-		L	Bead L	L		-				-
139	14	15	60	58	42	44	46	26					+	+	V S C O L	V S Y O L	Same	Comparative Congestion	+			+T+O-LS	
140	18	16	55	58	54	32	38	26					+	+	S C O L	V S Y C O L	Less		+		+		
141	18	16	16	18	27	44	48	26					+		L		L		-			+T-O-LS	
142	18	10	37	43	52	36	42	24					+		S C O L	S Y O L	Same	Same	+	+	+		
143	20	18	52	55	48	28	18	10					+		M B F L	M W O L	Drying	Decreased	+			+T+O-LS	
144	14	14	60	64	60	52	46	36					+	+	S I B T F	T Bead	W Bead L	Dried	+			+T+O-LS	
145	20	18	34	39	46	56	64	44					+	+	V S C O L	V S C O L	Drying	Decreased	+	+	+		
146	20	24	46	24	32	30	34	26					+	+	S C O L	S C O L	"		+			+T+O-LS	
147	30	22	58	51	41	26	30	30					+		M B C O L	M W O L	F T L		+			+T+O-LS	
148	16	14	56	54	32	14	14	12					+		N C P L	M C O F	M C O L		+			+T+O-LS	
149	18	20	33	28	40	26	24	20					+						-			+T-O-LS	
150	20	22	54	71	68	52	54	34					+		S I B				-			+T-O-LS	
151	14	12	61	53	36	26	30	34					+	+	S I B T F L	M W O F	Less	Same	+			+T+O-LS	
152	14	14	39	50	50	40	38	20					+		S C O L	S C O L	Dried		+	+	+		
153	16	16	11	18	14	20	20	16					-		M B T F L	M B O L	Same	Same	+	+		-T+O+LS	
154	14	20	25	24	26	26	30	22					-		L h				-				-
155	20	16	29	42	56	54	58	30					+	+	M C O L	M C O L	Same	Same	+			+T+O-LS	
156	14	13	31	36	44	40	58	40					+	+	S C O L	V S C O L	"	"	+	+	+		
157	20	14	49	33	48	40	20	16					+		M B T F	M B T O F	Dried		+	+	+		
158	16	14	16	15	18	24	28	22					-	+	M B T F L	S T F L	"		+	+		-T+O+LS	
159	16	10	49	38	26	18	22	16					+	+	M B T F	M B O L	"		+			+T+O-LS	
160	20	20	11	16	20	14	16	16					-		S I T	M W O	L Congestion	L congestion	+	+		-T+O+LS	
161	16	21	46	47	40	34	48	48					+		S I B T	L			-	+		+T-O+LS	
162	16	20	34	46	50	32	36	20					+		S C O L	V S C O L	Same	Same	+	+	+		
163	18	18	27	26	20	20	26	26					-			Bead L	L	"	-				-
164	14	18	57	59	60	64	66	56					+		M C O L	M W O L	Dried	Dried	+			+T+O-LS	
165	18	16	56	49	38	22	26	14					+		V S C O L	V S C O L	Same	Same	+			+T+O-LS	
166	18	19	18	19	16	14	18	14					-						-				-
167	20	19	14	12	14	12	18	10					-		L	S I Bead W L			+			-T+O-LS	
168	10	15	26	54	36	16	12	20					+						-	+		+T-O+LS	
169	10	16	43	46	48	32	32	20					+						-	+		+T-O+LS	
170	16	16	38	54	26	12	26	20					+		S I B F L	Bead W L	Dried		+			+T+O-LS	
171	10	12	30	42	40	24	26	22					+		S C O L	S C O L	Less		+	+	+		
172	10	14	21	20	30	32	34	30					?		S A C O L	S C O L	Same	Same	+	+		?T+O-LS	
173	20	22	39	42	36	30	40	32					+	+	S I B				+			+T+O-LS	
174	12	16	12	10	10	12	10	10					-						-				-
175	18	20	47	60	50	40	38	20					+	+	S C O L	M C O L	Less	Less	+	+	+		
176	18	17	18	24	24	20	16	16					-						-				-

Instilled ½ c c Concentrated Tuberculin (O.T.) Left eye № 119 to 176 incl 1-VIII-16

Injected Subcutaneously on left side in front of shoulder 2 c c of Diluted O.T. (1 to 7) at 4.30 P.M. 5-VIII-16

10% O. T., and 10, 2 and ½% precipitated tuberculin. Our findings are in accord with those of Haring. The temperatures recorded in this table and in table 3 were taken beginning with the ninth hour. We should have liked to begin with the eighth or even the sixth hour, but the owner of the herd was not compelled to have his herd tested, nor did he especially desire to have it done, and it was as an extreme favor to us that he permitted it. Hence, we were glad to have him permit us to handle them as we did. It should also be noted that 3 hours elapsed between the third and fourth post-injection temperature. This was due to the fact that we turned the cattle out and had a little difficulty in bringing them in at this unusual time of day. In cases 63, 67, 68, 91, 92, 98 and 115, where there were slight rises over previous temperatures, another temperature was taken at 9:30 with no increase over the temperature of 8:30 A. M.

It will be noted that in our interpretations of the secondary ophthalmic reaction we did not demand quite as much as in the case where we gave a second instillation of concentrated tuberculin. We took into consideration that the reaction was the result of a stimulation of subcutaneous or intradermal injection of tuberculin and the direct introduction of any irritating material into the eye that may be present in the tuberculin could be eliminated and for that reason the secondary reaction, even though it does not give as large a percentage of reactors as the two instillations, has in its favor the fact just mentioned. Foth, Jowett and others have felt that the glycerine present in the concentrated tuberculin (in our case 40%) may in itself have an irritating effect upon the eye and set up a slight inflammation. Foth tested the effect of 50% solution of glycerine on the eyes of 15 cattle and found that only reddening and lacrymation would result from it and that these would very soon disappear.

With this combination we had one tuberculous animal (No. 91) in 59 that failed to give a definite reaction to one or more of these tests, and that animal would not have been considered by us a distinct negative, since at the ninth hour it showed a temperature of 103.2 with a gradual decline in the following temperatures. Attention is called to the fact that in animals 106 to 116 inclusive, where the smallest dose of tuberculin 1/10 c.c. of 5% precipitated, was used, equally good results were obtained as when four times that dose, 1/5 c.c. of 10% precipitated was used.

From comparison of tables 2 and 3, we may infer that at least equally good thermic reactions can be obtained by the intradermal as by the subcutaneous injection of tuberculin. Besides, with the intradermal method one has the advantage of more pronounced and more regularly appearing local reaction.

Table 3:* Here we have practically the same combination as in table 2 except that the tuberculin was injected subcutaneously in front of the shoulder. With this combination we had poorest results. It is to be regretted that in this particular case such an unusually large percentage of tuberculous animals should fail to react to the subcutaneous injection. The animals in those two strings from outward appearance and from history were of the same type as the other strings, except string No. 1 where there were several advanced cases.

The local swellings recorded in this table are of special interest since in five cases, 122, 153, 158, 160 and 172, they were present where the thermal reaction was absent. In all but one of these (122) the secondary ophthalmic reaction was also present. We took the observation on local reaction at the 48th hour and from our experience with the intradermal test we should not take into consideration a swelling that is found only while the usual post-injection temperatures are being taken. Our experience with local subcutaneous swellings is very limited, but all those recorded as positive were distinct.

Conclusions. We will not figure the percentage of failures of the various forms of tuberculin testing in detecting tuberculous animals, nor will we compare the various tests. The figures are before you. The fact that any of these tests will fail in a noticeable percentage of cases has been made evident and it has further been established that tuberculous animals, while giving negative results to one form of tuberculin application, may give positive reactions to another form. Therefore, the value of combining two or more of these tests should need no argument and no herd should be accredited as free from tuberculin reactors unless a combination of tests has been performed and then only after such a test is followed up by a further test six weeks later upon all non-reacting cattle. The value of the follow-up test is to detect animals in the incubation stage or those which are insensitive to tuberculin for

*Case 128 recorded as negative is a distinct thermic reactor.

other reasons at the time of the previous test. We have no special combination to recommend but it seems that the ophthalmic, either sensitized or secondary, together with an intradermal injection, making a record of thermal reactions resulting from such injection, is a very satisfactory combination, since with this combination, all three forms of tuberculin reactions will be brought into play with the least danger of making the animals tuberculin insensitive or immune. From our tables it promises to give the best results, and it should be followed up in 4 to 6 weeks with the subcutaneous test upon all the non-reactors.

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DISCUSSION

DR. CAHILL: I would like to ask whether or not with the intradermal and ophthalmo tests, there was an opportunity to check up results by post-mortem. Also whether or not there is any belief that either one of these tests overcome the weakness that we have always recognized in the subcutaneous, by being able to detect by the reaction any connection between the intensity of the reaction, or the intensity of the infection.

DR. FITCH: I would like to ask in regard to the system or method of performing the subcutaneous test particularly in relation to the number of preinjection temperatures, the times at which these were taken and the number of times of taking the temperatures following injection.

DR. KINSLEY: I feel like sympathizing with those of you who are in communities where you must apparently maintain so many tubercular animals. In the central part of our country, we feel that we have taken this situation sufficiently early, and I do not believe that we have to contend with the immense numbers of tubercular animals that have been reported here. In Missouri we test annually several thousand cattle. We have found, apparently, so far as future tests are concerned, that we have reduced the number of tubercular animals to practically a minimum. We have met with obstacles.

In our state the recognized test is the so-called intradermal method. In testing from the yards, of shipped in cattle for three years prior to practically a year ago, that is, from 1912 in August, to 1915 in August, we tested something like between ten and eleven thousand cattle, practically all of them, without indicating more than one or two out of three or four thousand head that passed without reaction. During the past year while the Chicago yards were closed, we received in our yards many cattle from the north of the United States, Minnesota, the Dakotas, northern Iowa, Nebraska, and some from Illinois. These cattle apparently had a higher per cent of tubercular animals than those we were accustomed to; and apparently these animals had been tuberculin tested and were immune, so to speak, from the action of the tuberculin. In one instance, perhaps one or two animals went out into a dairy composed of thirty animals and in that dairy we found this spring on re-test, 22 out of 26 animals tubercular; on post-mortem the indications were that they were all recent infections, except one; that had, no doubt, not reacted to the test.

The doctor reported one herd where there was a retest where he had sixteen reactors, an alleged failure of reaction, or perhaps failure of detection by the intradermal method. I am wondering how many new animals, if any, were introduced into this herd, and what means they have of knowing that these introduced animals were not tubercular reactors. We have found this the greatest

source of tuberculosis in our dairy herds. We have apparently had little trouble in keeping herds free, except where some animals have been picked up in the country and come in without having been tuberculin tested, and which carried the infection in that way. In the lesions that have been mentioned as tubercular, no doubt they have been proven tubercular or as carrying tubercular bacilli.

DR. TURNER: I would like to ask if any of these animals that were tested within the three months, if the tubercular animals escaped all of the tests. Don't you think that the subcutaneous test applied before the intradermal test interferes with the intradermal reaction? On the question of retesting subcutaneously, have you tried testing subcutaneously within three or four days or within a week with good results? In connection with the ophthalmic or the double ophthalmic test, or sensitizing, have you ever sensitized and applied the second droppings in twenty-four hours with good results? I would also like to ask in making retests or testing herds semi-annually, whether you do not find that the animals become loaded up and do not respond to any of the tests properly within six months and if your results are bad?

DR. ELIASON: The proof of the pudding is generally in the eating. We have tried out some cases in herds that have had a certain percentage of reactors in them by slaughtering the herd outright. In one case of forty animals in which twenty-five reacted, the whole herd was slaughtered with the consent of the owner. Every one of the animals showed lesions on the post-mortem.

DR. HARING: Every one of the forty?

DR. ELIASON: Every one of the forty.

DR. HARING: What method of testing was used?

DR. ELIASON: The subcutaneous test. I can cite several cases of a similar nature; and our experience showed that where a certain number of reactors are in a herd, you might as well treat that herd as a tubercular unit. I don't care what number of tests you apply. They have the infection, and you will get them on a later test if followed up.

DR. KINSLEY: How long before that test was the previous test? You don't know that they were not previously tuberculin tested.

DR. ELIASON: They were not previously tested. Just a word of explanation in reference to this herd. The owner was a tenant on a farm in the western part of the state who had accumulated a herd of pure bred Holsteins. He made arrangements for a farm in Minnesota, and asked for inspection before shipment. I am satisfied from the circumstances that he did not suspect tuberculosis. When I say that they were not tested, I mean they had not been tested on this man's premises, and it was some years since he

had bought. When there was fifty per cent of reactors the results were reported to Dr. Ward before any further move was made. He informed the owner that he did not wish to have the balance shipped into the state of Minnesota. It was then that the owner asked if we would condemn the whole herd, and it was done.

We have tried this out in a number of cases, and the results have been about the same. With all due honest attention on the part of the owner and everybody concerned, if you have fifty per cent of reactors in a herd, don't think for a moment that you can save a certain percentage of them. You can save them for a few years, but they will react some time. We have tied up the public into a sentiment that you can put the cattle in a sieve and sift out the well ones. I want to assure you that there is no such process. We should teach the public that the thing to do is to find out which herds are infected, and to keep those animals there and stop the dissemination of the diseased and exposed animals. I want to tell you that you can test cattle from now until doomsday without any results unless we take the bull by the horns and make a universal test. The greatest hindrance to the eradication is the cumbersomeness of the subcutaneous test. If it had been possible to unite on a test which is as simple as the intradermal, for instance, we might have gotten somewhere, but you will never get anywhere with a system as cumbersome as the subcutaneous test, which we are using now. What we are doing is just about as good as an advertisement in the papers. We are feeding the public with the sentiment that when a man is getting a certificate of health from a veterinarian that he is fully protected, and if he finds that he is not, or in other words, if he finds tubercular animals among his cattle in subsequent tests, the man who owned the cattle previously, and the man who tested them are promptly designated as crooks.

Let us educate the public to be just a little more charitable in the eradication of this disease and not set one man up against another in a court over a test which is a test only so far that when an an animal reacts it may be considered tubercular. No test, however searching, can overcome the factor of contamination shortly before test or the dormant case which may show up at any later test.

The tuberculin test is the best method of protecting a herd against tuberculosis but it must be used regularly in order to procure results. We should also explain to the layman our difficulties and get his cooperation. The application of common horse sense before censure will help a whole lot.

DR. WINCHESTER: I note there has been a good deal of opposition to the tuberculin test in certain localities. Can the public come to us and approve the tuberculin test when we present to them the fact that such a large percentage of individuals die from bovine tuberculosis? Ought it not to be put to them as a matter of conservation of human life?

DR. EICHHORN: Dr. Hart brought out very strongly the advisability of using a combination of tests for the diagnosis of tuberculosis. It must be realized that in our desire to control the disease and to eliminate possible failures, it would be of advantage to employ a combination of tests, and possibly also to devise other tests which might be applied with satisfaction for the diagnosis of this disease. The application of the complement fixation test for the diagnosis of the various diseases in human beings and animals suggested also the possibility of this test in tuberculosis. The applications on this subject relative to human tuberculosis are quite numerous, but the results obtained were not uniformly satisfactory. Although it is generally claimed at the present time that when the test is properly applied to human beings, it might be utilized for the determination of the course of the disease, especially in progressive cases. In applying this test to bovine tuberculosis, various investigators employed different antigens to determine whether it could be utilized as a supplementary test or otherwise for the elimination of such cases which possibly had escaped other tests.

We have undertaken in the last year to test a large number of animals by this method, and aimed to determine whether we might not be able to devise an antigen which would be more accurate than any used for the test by previous investigators.

For this purpose we have run comparative tests with different antigens used by various investigators for the diagnosis of human cases, and also such as were employed in bovine tuberculosis. In all, about a thousand animals were tested, and we found that an antigen which we have devised, consisting of a combination of tuberculin precipitate prepared in a manner somewhat similar to the fractionization of antitoxin sera with an emulsion of tubercle bacilli gave the best results; but even at that, with such an antigen which proved superior to any heretofore employed in this test, we could only attain an accuracy of about 82 to 83 per cent. While it is not recommended that this test should be employed in connection with the diagnosis of bovine tuberculosis, at the same time it might be utilized from time to time as a supplementary test, especially where it is desirable to employ a combination of tests. For the present this test is principally of scientific interest, and considering the large number of animals tested, the results obtained might be given due consideration by investigators engaged in this line of experimentation.

DR. HADLEY: The question is often asked, what would you do if you tested a herd of cattle and found ten per cent of the cattle to be tubercular according to the intradermal test? That is a very important question from the standpoint of the veterinarians as well as from the standpoint of the owner of the cattle. Personally, I suppose all have had some experience in handling such cases. In my own case I would be very loath to give a bill of health to 90 per

cent of non-reactors. I always feel justified in telling the owner as well as the purchaser, in order to protect myself, as well as them, that in all probability at the next test more cattle, which at the first test appeared to be perfectly healthy, would react. We are not quite fair to ourselves in this tuberculin test, or to the owner or to the purchaser of the cattle. We have relied too much in the past upon the accuracy of the test, and have not taken into consideration its limitations.

DR. HART: The first question asked was whether we checked the results by post-mortem examination. In the animals represented by the tables thrown upon the screen we did not check the results by post-mortem examinations. We have had 750 tubercular animals on this ranch, and we now have 450. There have been approximately 300 tubercular cattle killed from this ranch; about half of them have been examined, and there have been only 3 or 4 animals killed that did not have tubercular lesions. There are animals at the present time on this ranch in all stages of the disease, those used in this work had twice reacted to tuberculin on previous occasions, and we felt that these animals were all tubercular. If we had had a little longer time to arrange our plans we would have purchased and killed the non-reacting animals which were three in the two tests and 13 altogether out of 176. But we considered. and we think justly so, that all of the 176 animals in these tables were tubercular.

The intensity of the reaction bears no definite relationship to the degree of infection. This is true also in the combination tests no matter which you use. There is no relationship between the intensity of reaction and the intensity of infection.

As to the system used in the subcutaneous tests asked by Doctor Fitch. In this case we took two previous injections; one about 1:30 to 2:00 in the afternoon and the other about 3:30 to 4:00 in the afternoon. The cattle in this dairy were put in the stanchions from 1:30 to 5:00 in the afternoon, and 1:30 to 5:00 in the morning. We started to inject these cattle at 4:30, and we commenced taking temperatures at 1:30 A. M. There was a period of nine hours between injection and the first temperature, which we admit was one hour too long. In the second table we missed one animal, and we think if we had gotten her on the eighth hour she would have shown a higher temperature than 103.2. We feel that the first temperature should be taken in eight hours and in some cases, especially where they are advanced, even earlier than the eighth hour is preferable; but in this particular series of tests we were unable to get at them until the ninth hour, and such conditions frequently arise in routine work.

The introduced animals, mentioned by Dr. Kinsley, is the greatest difficulty that we have to contend with in California, the introduction of new animals. In California, the land is very valuable

around the large cities, and dairymen who wish to raise their own heifers, are unable to keep those heifers on their own ranches until they are ready to milk. Thus, after they pass the weaning period, they are sent various distances to mountain ranches where they are mixed with other cattle and are then brought back to the dairies at the time they are fresh and they bring tuberculosis back with them. Auction sales are very frequent in that country, and this introduction of animals is the most serious thing that we have to deal with in the control of tuberculosis.

Dr. Turner asked if there were any of the animals which escaped the combination tests. In table number 1 we missed two animals with that combination; in table number 2 we missed one animal; in table number 3 we missed ten animals. The subcutaneous test interferes with the intradermal. I believe that the intradermal test, inasmuch as it will produce a thermal reaction, does interfere with the subcutaneous test, just as the subcutaneous will interfere with the intradermal test given three or four days later. The only test that is not seriously interfered with by other tests is the ophthalmic test. The ophthalmic test has the great advantage that it can be applied immediately after another test has been given. While the percentage of accuracy is not high, if you test a herd of cattle with the subcutaneous test and do not get any reactors, and yet you suspect the owner, and give the sensitized ophthalmic test and get some reactors in the herd, you will know that something has been done with the cattle to make them immune and that is one great value of the ophthalmic test.

A NEW AND ECONOMICALLY IMPORTANT TAPEWORM *MULTICEPS GAIGERI* FROM THE DOG*

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An examination of the tapeworms described by Gaiger (1907) as *Coenurus serialis* shows that they belong to a new species which is described in this paper and named *Multiceps gaigeri* in honor of Doctor Gaiger.

The parasites of the dog are always of interest as they are to a certain extent an index of the conditions of human parasitism in the same localities. The presence of certain tapeworms in dogs is indicative of careless and improper methods of disposing of

*Presented in abstract before the A.V.M.A., at Detroit, August, 1916.
†Resigned September 19.

slaughterhouse refuse and a corresponding danger to people who obtain meats from houses so conducted. The presence or absence of hookworms in dogs, within certain limits, as indicative of meteorological conditions favorable or unfavorable to the extra-corporeal life cycle of hookworms in general. The importance of the parasites of the dogs, and their effect on the health of man and the domesticated animals, has been discussed at length in a previous publication by the writer (Hall,1915).

Multiceps gaigeri Hall, 1916, new species.

SYMPTOM.—*Coenurus serialis* Gervais, 1847a, of Gaiger, 1907, and Dey, 1909.

SPECIFIC DIAGNOSIS.—*Multiceps*: The head is somewhat piriform in lateral view and almost square when viewed *en face*, and is about 950 μ in diameter. The weak rostellum is about 360 μ in diameter and bears a double crown of 28 to 32 hooks. The large

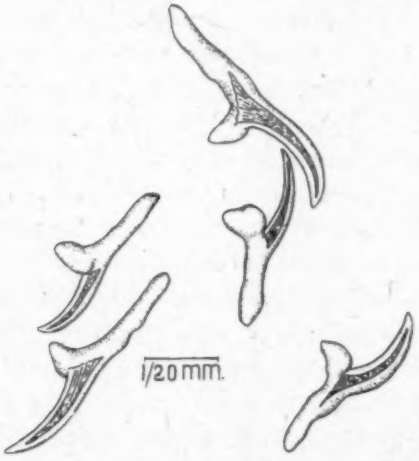

FIG. 1. *Multiceps gaigeri*. Large and small hooks.

hooks (Fig. 1) are 160 to 180 μ long. The blade is of slight curvature; the handle is nearly straight or only slightly sinuous, with usually a notch, slight or very pronounced, on the dorsal border between the middle of the handle and the union with the blade, the dorsal and ventral borders approximately parallel and the handle not tapering but ending bluntly and at times with a slight curvature dorsally at the distal extremity; the guard is approximately cordiform in lateral view, the point of maximum thickness being a short distance from the union with the blade and handle, thus forming a neck proximally and a roundly conical distal portion.

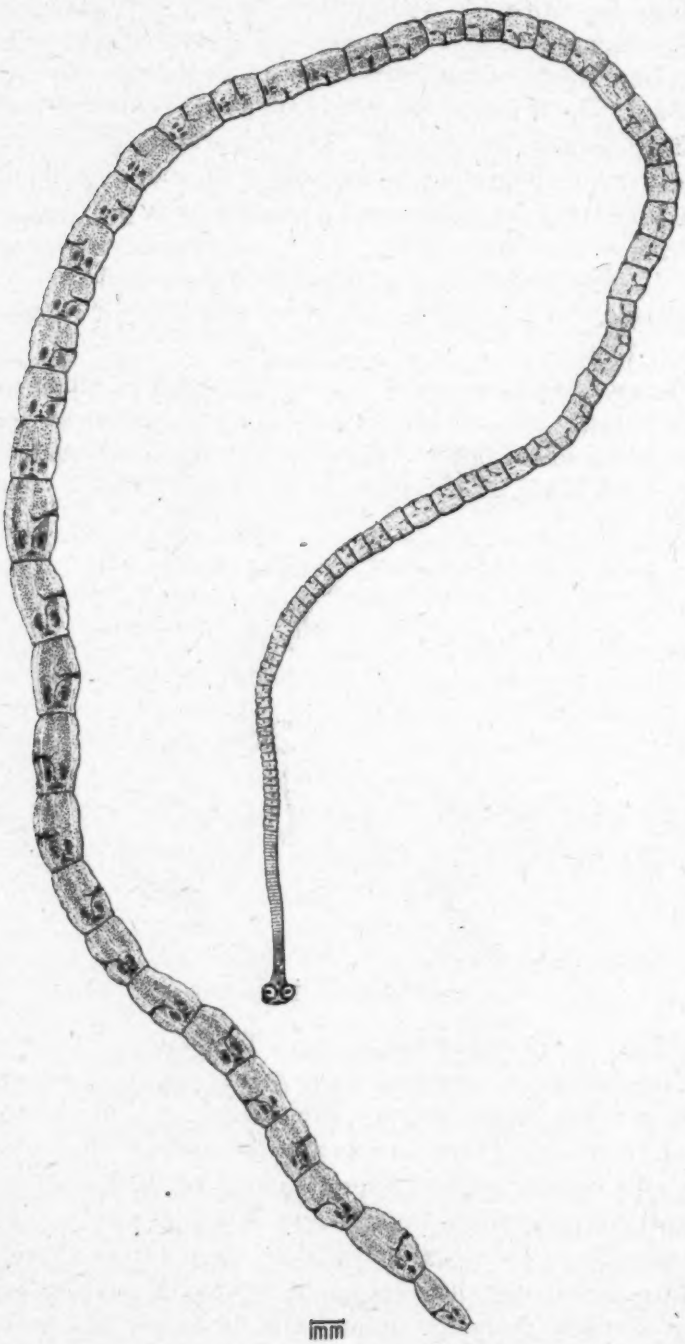

FIG. 2. *Multiceps gaigeri*. Young strobila.

The small hooks are 115 to 150 μ long. The blade is strongly curved; the handle is long, straight, slightly sinuous in outline, and tapering to a rather blunt tip; the guard is rather oval in lateral view, has a slight median ventral depression without being bifid, and meets the handle at a very obtuse angle, almost a straight angle. The suckers are comparatively large, set prominently at the angles of the quadrate head and with relatively small intervals between adjacent suckers, and have a bulb diameter of 310 to 330 μ. The neck is quite distinct, of smaller diameter than the head, and may measure around 690 μ in length. The entire strobila may measure from 25 cm. to 1.82 meters, according to conditions and individual development. In well developed strobilæ, about 40 cm. long, the segments become square about the middle of the strobila, being 5 mm. long and 5 mm. wide at a distance of 20 cm. from the head. As the segments become longer than wide they become mature. At 30 cm. from the head they are 7 mm. long and 5 mm. wide. At 40 cm. from the head the segments are 14 mm. long and 2 to 3 mm. wide. The entire strobila is rather thin, delicate, and comparatively translucent (Fig. 2). The genital primordia appear in about the thirtieth segment, between 2 and 3 mm. back of the head, first as deeper staining areas in the median line. These areas become angular, the legs of the angles forming the genital canals. The primordium of the median stem of the uterus is the next thing visible. Calcareous corpuscles are especially large and abundant in the medullary portion of the head and the anterior portion of the neck, where they are elliptical and about 13 by 8 μ in diameter, but are elsewhere small, oval, around 4 to 5 μ in length, and, though numerous, are relatively inconspicuous. The longitudinal excretory canals are quite distinct, the ventral canal situated about 225 μ from the margin of the segment and the dorsal canal lying lateral of this. The genital papilla is flat and inconspicuous, an actual papilla formation being lacking as a rule, but is readily observed owing to the translucency of the segments.

Male genitalia.—There are between 200 and 225 large, irregularly spherical testes, confined principally to the lateral portions of the median field in the vicinity of the longitudinal excretory canals (Fig. 3). There is a wide field about the median stem of the uterus which is free or comparatively free from testes, only an occasional two or three occurring here. The field about the vas deferens and vagina is also comparatively free from testes for

some distance on each side. The testes press close to and even in contact with the lateral borders of the ovaries and also extend to the vitellarium and between the vitellarium and the ovaries. The vas deferens begins close to the median stem of the uterus on the pore side and first extends at an angle posteriorly and laterally. It is very much looped from its origin, the loops extending widely along the longitudinal axis of the worm, even across the vagina, and also back and forth along the general path of the vas deferens, the loops being so numerous as to form a dense wide structure. The cirrus pouch extends to the median border of the ventral excretory

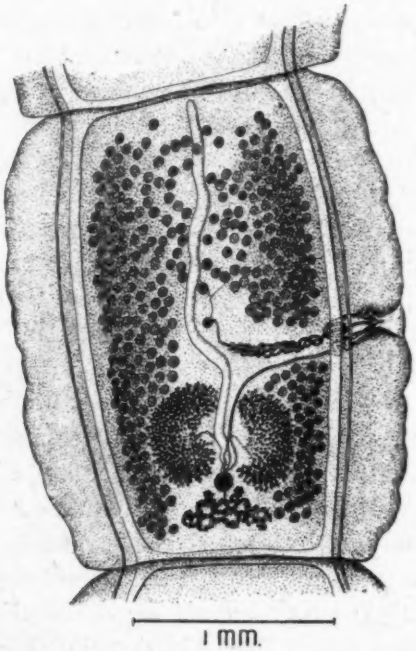

FIG. 3. *Multiceps gaigeri.* Mature segment

canal. It is piriform to elongate elliptical in shape, often with a concavity on the posterior side, toward the vagina, and about 260 μ long by 100 to 125 μ wide.

Female genitalia.—The ovaries (Fig. 3) are elongated along the longitudinal axis of the strobila, of the same size, and reniform to fan-shaped, the inter-ovarian field varying correspondingly from oval to almost quadrilateral. The vitellarium is roughly triangular in outline, the anterior angle projecting a short distance into the inter-ovarian field and occasionally suppressed at this point to

form a truncated or even invaginated structure for the reception of the shell-gland. The vitellarium is often irregular or asymmetrical and in some segments may even be elongated along the longitudinal axis of the strobila, a quite distinctive feature (Fig. 4). The vitellarium does not extend laterally as far as the ovaries

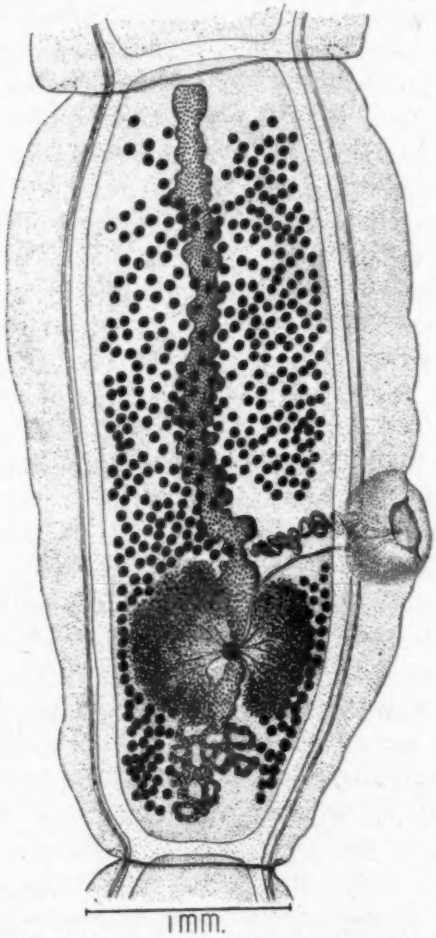

FIG. 4. *Multiceps gaigeri.* Mature segment showing the occasional elongation of the vitellarium along the longitudinal axis of the strobila.

do. The shell-gland is comparatively large, at times distinctly in the clear near the anterior apex of the vitellarium and at times apparently in contact with the vitellarium or occupying an invagination at the anterior apex of the vitellarium. The vagina follows the general contour of the portion of the cirrus pouch lying nearest the lateral margin of the segment, being straight when the cirrus

pouch is straight and following the concavity when the pouch is concave posteriorly. It then bends abruptly, usually at right angles, but at times at an obtuse angle or again at an acute angle back toward the margin of the segment. It then turns medially and after pursuing a short wavy course, with usually two crests, or even making another loop, it swings in a wide curve around the nearest ovary to the receptaculum seminis in the inter-ovarian field. In gravid segments the median stem of the uterus is very wide and has from 12 to 15 wide lateral branches which in turn send out wide secondary branches. The median field of the narrow segments is thus reduced to nearly a solid mass of eggs, the space between the wide uterine areas being very small. The eggs are nearly spherical and are 25 to 30 μ in diameter.

HOSTS.—Primary: *Canis familiaris.* Secondary: *Capra hircus.*

LOCATION.—In small intestine of primary host. In central nervous system, liver, lungs, spleen, kidney, bladder, intermuscular connective tissue, under peritoneum and subcutaneous in secondary host.

LOCALITY.—India (Punjab, at Lahore, and Bengal) and Ceylon.

TYPE MATERIAL.—U. S. National Museum No. 16590. (Bureau of Animal Industry Helminthological Collection.)

LIFE HISTORY.—Eggs produced by the adult worm in the primary host, the dog, pass out and are ingested by the secondary host, the goat, in contaminated food and water. In the digestive tract the embryo escapes from its shell and bores into the tissues of the host where it gives rise to a larval form, or coenurus. On ingestion of this larva by the primary host, some or all of the heads attached to it may give rise to strobilate worms in the intestine.

Gaiger (1907) first recorded this parasite from the goat at Lahore, India. He had two cases of the larval parasite occurring in the connective tissue, and because of the site of the worm and the presence of what he regarded as daughter cysts, he concluded that the parasite was *Multiceps serialis,* the bladderworm commonly found in the connective tissues of the rabbit, rather than the gid bladderworm, *M. multiceps,* the form commonly found in the central nervous system of ungulates. He fed some cyst material to a dog and to a rat. The rat died in two days and the hooks were recovered from the stomach. The dog began passing segments of tapeworm on the fourteenth day and was killed on the thirty-first day. The small intestines were found packed with tapeworms from 1 to 40 cm. long.

Two years later, Dey (1909) reported this parasite from the goat in Bengal, India. In this case the parasites were found in the brain, intermuscular connective tissue, in subcutaneous situations, and in the mesenteries and attached to the peritoneum of the abdominal wall and the serous covering on the viscera. A dog was first treated with taeniacides and purgatives and then fed some cyst material. In a month and a half the dog began passing segments of tapeworm and was killed two weeks later. Seventy-five tapeworms, the longest 1.82 meters long, were recovered from the small intestine, and the scolices found to agree with those of the coenurus.

Southwell (1912) reports *Coenurus serialis* from the goat and *Taenia serialis* from the dog in Ceylon. The record from the goat must be regarded as a record of *M. gaigeri* and that from the dog may be.

Gaiger (1915) lists it from the goat in India with a note to the effect that it is common.

In a previous paper (Hall, 1910b), Gaiger's and Dey's records of *M. serialis* from the goat were provisionally accepted as correct, with a note to the effect that the parasite would receive further attention later. Through the courtesy of Doctor Gaiger, specimens of the coenurus from the goat and of the tapeworm from the dog were furnished to the U. S. Bureau of Animal Industry, and an examination of these showed them to be a new species. That there are no rabbits in India, a fact Gaiger (1909; 530) has himself noted, would suggest something of the sort. The specimens of the adult worm are much smaller than the largest specimens noted by Dey, but as the size depends largely on whether fresh material is measured in a stretched condition or preserved material is measured on a flat surface, this is a small matter. In the specimen which I have designated as type, the segments are mature about 5.5 to 6.5 cm. back of the head. The general anatomy of the species is much more nearly that of the gid tapeworm, *M. multiceps*, than *M. serialis*. The strobila is delicate and the vagina shows a peculiar bend which is strongly suggestive of the condition in *M. multiceps*. The hooks are also suggestive of *M. multiceps*. Gaiger states that the small hook has a bifid guard, but this statement is often made of tapeworms that do not have a bifid guard. In these cases, as in this species, there is an appearance of bifidity found on focusing which is due to the fact that the lateral mar-

gins of the guard are commonly thickened and the median ventral portion thinned and often slightly grooved, but such conditions must be differentiated from the condition of true befidity which is found in such hooks as those of *Taenia pisiformis.*

An examination of the larva shows it to be more closely related to the gid bladderworm, *M. multiceps,* than to *M. serialis* morphologically. Placed in a dish with typical specimens of these species it resembles the former much more than the latter, and the same is true of scolices detached from all three species. Gaiger (1907) states "There was a very distinct tendency in most cysts towards budding off of daughter cysts, and although actual separation of a daughter cyst was not seen, in one case there was a distinct neck dividing off a portion of the parent cyst. Internal budding was complete and many of the cysts were floating free. The daughter cysts were never more than 2 mm. broad and 4 long, and were always egg-shaped with one head at the narrow end. The majority of them were attached by a minute pedicle to the parent cyst, but could be easily detached, and often they were present in bunches, both attached and free." I find on examination that a striking feature of this species, so far as the available material is concerned, is the extraordinary ease with which the heads detach from the bladder wall and so come to lie free in the internal fluid. The great majority of the heads in the available specimen are free and lie in a mass inside the bladder, their former position being marked by neat prominent apertures perforating the bladder wall. This is the obvious explanation of Gaiger's statement regarding daughter bladders. These are deciduous scolices, but they are not daughter bladders. It is interesting to note that we have here a condition suggestive of what must have been the origin of daughter bladders, namely, a deciduous scolex, but it is so recent a development here that the cyst has not yet developed a reparative process at the site where the scolex separates. This species is apparently intermediate between *M. multiceps* and *M. serialis* in this and other respects. It presents an interesting study from a physiological standpoint in that it is capable of development in the central nervous system and also in the connective tissues and on serous surfaces, thus combining the sites of the other species, and causes the formation of an adventitious capsule, as *M. serialis* does and *M. multiceps* does not, even adhering tightly to the brain, from which *M. multiceps* slips very easily and with no trace of adhesions.

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A COMMON OR PUBLIC NUISANCE—THE TUBERCULAR MILCH COW*

J. F. WINCHESTER, Lawrence, Mass.

I have the honor as well as the privilege to call attention to *centers* of the *cause* of the most dreaded disease in mankind that is preventable.

"A common or public nuisance is one which tends to the annoyance of the public generally, and is therefore to be redressed by forcible abatement, or by an action by the State."

That the tubercular milch cow is a common or public nuisance has been proven by the demonstration of the bacilli of Koch, or the tubercular bacilli, in the milk of such animals. That the milk from such animals is an annoyance to the public generally, is shown by the percentage of human beings whose deaths have been caused by or who have been made cripples by its use. The abatement by force will not be tolerated, but legislative action can correct the nuisance.

*An address presented at the Massachusetts Association of Boards of Health, Holyoke, Mass., Oct., 1916.

That the bovine type of the Koch bacillus does appear in the human subject, causing death and disability, has been demonstrated by various investigators. Eastwood and Griffith, in Great Britain, have made a report of the relative distribution of the various strains of tubercle bacilli in human bone and joint tuberculosis.

For the investigation, the material examined was removed directly from an affected joint or bone, or from an abscess in the neighborhood of such lesions. Out of a total of 261 patients, 55 or 21% were bovine cases. Of these only 3 were over 16 years of age. 155 cases were examined under 10 years of age, and 45 or 29% were bovines.

Dr. M. J. Ravenel, of the University of Missouri, writes, "The transmission of tuberculosis from cattle to man through milk is no longer doubted by anyone. The danger is particularly great in children under 5 years of age, but is marked in all children from birth to 16 years, *apparently diminishing* after that time."

Dr. Wm. H. Park gives a summary of patients, who have died from tuberculosis, as follows: adults, 16 years and over, 955 cases; 940 human, 15 bovine; children, 5 to 16 years, 177 cases; 131 human, 46 bovine; children, under 5 years, 368 cases; 292 human, 76 bovine.

Dr. Park further states that 10% of the fatal cases of tuberculosis among children was due to bovine bacilli; that of all the children which were fed with raw dairy products one-half died of bovine bacilli; and that about one-half of all the people, younger children and older children, that had gland tuberculosis, had bovine infection.

Dr. Delphine says, "Taking all evidence into consideration, it is possible to say, without fear of exaggeration, that not less than 25% of the children suffering from tuberculosis, under 5 years of age, suffer from tuberculosis of bovine origin, and that this rate is much lower than one based on probabilities would be."

Dr. Mitchell, of Edinburgh, examined 72 cases of children suffering from cervical tuberculosis, and of these 65 or 90% showed bovine infection. There were 38 cases under 5 years of age, and of these 35 were infection from the bovine and only 3 from the human. Some of these cases led to death later, but all of them led to more or less disease and deformity.

Infant mortality in this state under one year of age, for 1913, was 10,086 from all causes, while 4,180 deaths are registered as be-

ing due to consumption that year, but the ages of the victims were not recorded in the report.

Clinically it is impossible to tell whether a patient afflicted with tuberculosis, is infected with the bovine or the human type of the tubercle bacilli.

Professor Eber, Director of the Veterinary Institute Laboratories at Leipsic, has repeatedly shown that it is possible to so alter the human type of tubercle bacillus, by systematic passage through animals, that, with the means at present at our disposal, they cannot be distinguished from bacilli of the bovine type.

His researches furnish abundant evidence that the two types of tubercle bacilli, the human and the bovine, are not types of subspecies with constant characters, but rather varieties of one and the same bacillus with relatively variable characters. He recognized that the bacilli cultivated directly from human or bovine sources possess certain biological characteristics, which permit of a distinction, in the majority of cases, between the human and bovine type.

The law that deals with the detection of tuberculosis in cattle is as follows: "Tuberculin as a diagnostic agent for the detection of tuberculosis in domestic animals shall be used only upon cattle brought into the commonwealth, and upon cattle at Brighton, Watertown, and Somerville; but it *may* be used as such diagnostic agent on any animal in any other part of the Commonwealth, with the consent in writing of the owner or person in possession thereof, and upon animals which have been condemned as tuberculous upon physical examination by a competent veterinary surgeon."

Tuberculin is used upon foreign cattle, but *not* upon native or Massachusetts cattle at Brighton, Watertown, or Somerville.

In August, 1916, 1,931 milch cows went through the Brighton stock yards, and of that number about 480 were native Massachusetts cattle or cattle that have been owned at least six months in this state.

Each year a physical examination of all cattle in the Commonwealth is made by the city and town inspectors, and if a contagious disease is suspected in any animal, that animal must be placed in quarantine, and a certified copy of the order sent to the Department of Animal Industry.

Subsequent to his report, an inspector, a veterinarian, or layman is sent to examine the animal in quarantine, and if, in his opinion, the animal is not diseased, said animal is released.

There appears in Public Document No. 98 the fact that 1,456 native cattle were suspected of tuberculosis by the inspectors—some inspectors are veterinarians—and of that number 194 were officially released.

It is recorded in Public Document No. 98 that 49 head of cattle were reported as reacting to the tuberculin test by veterinarians, and they were released as they could not be condemned on a physical examination by agents of the Department of Animal Industry.

To me it is paradoxical that one department of this state should permit the existence of centers of disease that carry contagion to man from diseased cows through milk, while another department should be under great expense, in being constantly supplied with patients and using all the energy at its command to *restore* the innocent victims to health.

The subject has an economic as well as a humanitarian phase, and should be kept under the spotlight of public opinion until remedied.

Since the duty of the Boards of Health is sanitation, and sanitation stands for prevention, can this organization do a greater service to the Commonwealth than to have corrected and revised Section 31, Chapter 90, of the Revised Laws as amended by Chapter 322, Acts of 1903, thus aiding in the conservation of "The Common Health of the Commonwealth"?

Dr. William M. MacKellar, who directed the forces which were successful in eliminating cattle ticks from the entire State of California, has been transferred to Atlanta, and will take charge of the work in the State of Georgia. The work in Georgia has progressed very rapidly and the Bureau of Animal Industry believes that the ticks will be eradicated from the State in a very short time.

TICK ERADICATION. Forty per cent of southern territory put under quarantine on account of the Texas fever tick on July 1, 1906, was released from quarantine on this account September 15, 1916, when the recent order releasing additional territory became effective. In all, 294,014 square miles have been freed from this pest, and there now remain under quarantine 434,529 square miles. Four states have completely eradicated the tick from their borders.

CLINICAL AND CASE REPORTS

"Knowledge is born in laboratories and in the experience of the thoughtful. It develops form in the journals and 'when dead it is decently buried in books'."

THE USE OF ARRHENAL FOR THE TREATMENT OF TEXAS FEVER

J. E. Aghion, State Domaines, Sakha, Egypt.

An important disease which affords great interest to veterinarians of this country at the present time, and which causes considerable loss to cattle owners, is Texas fever.

The disease is due to the presence in the blood of the protozoan known as *Piroplasma bigeminum*, which is transmitted from animal to animal by the cattle tick: the piroplasma causes destruction of the red blood cells, and as a consequence hemoglobinuria (red water) occurs.

It is not my purpose to give in this short paper, the history, symptoms, or diagnosis of this disease, but simply to state, as briefly as possible, how cases of Texas fever are treated, and the results obtained by the use of Arrhenal.

In the summer of 1912 the experiment of immunizing cattle against plague was started, in cattle belonging to the Domain's Administration, the method of double inoculation (virulent blood and serum) was applied.

While conducting the said experiment, we were confronted with a serious problem. The development of a severe form of Texas fever made its appearance in some animals after double inoculation; some cases even succumbed to the disease before the application of any treatment. The diagnosis of Texas fever was generally always confirmed, when slides collected from the blood of diseased animals were microscopically examined.

For treatment we started giving a hypodermic injection of trypanblue in a solution of 1–2%; this dose was to be repeated on the second day, if the temperature of the animal was still high: this method of treatment has, according to some reports, yielded 50–60% of cures.

In October 1913 my chief, Piot Bey, urged the use of Arrhenal instead of trypanblue. This was used in the form of a 10% solution. One injection containing 10 grammes of the above solution and, in severe cases, two doses were sufficient to bring about a

prompt cure. According to Piot Bey, the treatment of Texas fever by means of Arrhenal when the case is properly and immediately attended to, and when no complications of other diseases are present, has yielded in his hands 100% of cures. The use of Arrhenal for the curative treatment of Piroplasmosis is well established in this country and has been widely employed ever since 1913 and has, so far, given satisfactory and even excellent results.

Cases of Texas fever are now seen quite independently of other diseases. The last cases, I have seen and treated successfully with Arrhenal, were in the northern part of the Delta. Ten head of cattle were examined and found with typical symptoms of Piroplasmosis. All were treated with Arrhenal and had to be freed from ticks; a change of food was also recommended. Two days afterwards they were again examined and found to be doing better; the temperature dropped to normal, all were feeding and ruminating. The same treatment and management were again applied.

I may just mention that two days prior to my visiting this lot of cattle, the manager of the farm informed me that he had lost five head of cattle presenting exactly the same symptoms. A report from the manager, which I received on August 10th, states that all the animals are doing very well and have been working for the last ten days.

A LESSON

D. V. S.

One does not learn all his lessons in college. Here is one I might have learned but did not. It may be of help to some other practitioner.

I was called about 8:00 P. M. to see an aged horse that had suddenly gone "dead lame" while at pasture. A young man who had been hunting started to drive the horse to the barn. The old horse appeared to be frightened at the boy's gun, galloped a short distance, stopped suddenly and refused to move except on three legs.

The owner, an old German, took a lantern and went with me to the pasture. An examination revealed a comminuted fracture of the os suffraginus of the left front leg. The broken pieces would simply "squash" on pressure. It was a hopeless case as the

horse was at least twenty years old, so I told the owner I could do nothing for the horse and that he should be put out of his suffering. The old man dropped his lantern and throwing his arms about the horse's neck cried like a child. On my way back to the barn the old man, between sobs, offered to pay me for my visit, but as he was in rather poor circumstances and this was his only horse I had pity for him and made no charge. After I had left he sent eight miles for a non-graduate to see the case. This man confirmed my diagnosis and prognosis and took his fee.

I did not like it very well and the next time I met Herman on the road I told him so. He said, "Vell, you didn't charge me noddinks, so I takes dat money for de odder feller."

THE INJURY CAUSED TO THE DAIRY INDUSTRY OF PORTO RICO BY TEXAS FEVER

JUAN VARAS CATALA, San Juan, Porto Rico.

Native cattle are immune to Texas fever, because when young they have suffered more or less from the disease. The immunization does not necessarily preserve the health of the cattle, owing to the fact that a great number of their owners allow the ticks to continue feasting upon the animals which become and stay weak and anemic; with the result that the working bull dies and the dairy cow yields a very small quantity of milk. The ticks remain infested with the piroplasma, thus inoculating the non-immune valuable Holstein or Jersey cows when put on pastures in which native cattle, suffering from the disease, are grazing. I have attended many epizootics of Texas fever: I will cite two outbreaks: Mr. Antonio Pizá imported seventeen Holstein-Friesian cows from the State of New York. Prior to this I had advised Mr. Pizá not to bring cows from above the tick-fever line, but he insisted and proceeded to import them. They were taken to the pasture soon after landing and eight days after he informed me that his cattle were urinating blood and that some had died. I went to his farm, made a post-mortem of two, made blood smears, examined the latter microscopically, and the coccus form of the *Piroplasma bigeminum* was seen. No treatment did any good. During the short time of three weeks, all the cows died. Mr. Pizá lost about five thousand dollars.

Dr. L. Baptista imported sixteen head of Holstein cows also

from the State of New York. He was wise; he did not put them in the pasture. He put them in a cement floor stable and everything went well for about ten months. Last month he went to a certain town of Porto Rico to spend his vacation. The attendant of the cows drove them to pasture with the result that nine died from Texas fever. I think the rest will die if not taken good care of, because they are more or less infested.

These losses of Holstein or Jersey cows cause considerable injury to the dairy industry of this island. The native cows are poorly fed; grass only, and are poor milkers, the best of them giving from eight to ten quarts daily. The udder has very little glandular tissue.

The only advantageous condition that the native cow has, when freed from ticks and taken good care of, is the resistance to disease. A great majority of the native cows give birth to their young out in the fields, and if the calves are not healthy from the start, they will succumb. The native cows hardly ever get sick and never suffer from tuberculosis, because they are kept in the open at all times where they are exposed to the hot sun of the tropics and to the cold rains and winds. These factors contribute to their prolonged health. They do not suffer from contagious abortion. Their mammary glands are very resistant to the entrance of infection, therefore they hardly ever suffer from mammitis.

If we can succeed in crossing American tuberculin tested dairy cattle with native cattle, then the dairy industry in Porto Rico will be considerably improved, because then we may have a native cow with great endurance, free from tuberculosis, and yielding a great quantity of milk.

AN EPIDEMIC AMONG RABBITS— THE VALUE OF THE MICROSCOPE

JUAN VARAS CATALA, San Juan, Porto Rico.

Mr. Alfonso Fernandez, a resident of San Juan, P. R., informed me of the loss of forty-four rabbits in the short period of a month and requested an investigation to find the cause of death. I went to his yard where the remaining rabbits, numbering thirty-two, were kept in cages, three to each cage. In one I saw three dead. The live rabbits presented a yellowish secretion in their ears.

I made post-mortems and found the membranes of the external, middle and internal ears very inflamed and covered with dry, yellowish scabs, which examined microscopically, showed the ear mite (*Psoroptes communis cuniculi*). The rest of the organs were perfectly normal.

By the above mentioned findings I arrived at the conclusion that the death of the forty-four rabbits was due to the irritation produced by the mites. I advised Mr. Fernandez to apply sulphur ointment to the ears of the remaining animals and to disinfect thoroughly all cages. He did so and a few days later he came to my office to inform me that the mortality had come to an end.

VETERINARY WORK IN A LUMBER CAMP

S. J. ALCALAY, Frazee, Minn.

At our graduation banquet, the freshman who represented his class said: the course of anatomy and its beginning osteology was a very dry study for him. Great was his anxiety to reach the threshold of myology. His assumption was that since this branch of anatomy dealt with softer tissue, correspondingly its learning would be easier on his mind. But all his hopes were shattered when he heard the professor in charge of myology say that nowadays the study of myology is done on muscles hardened "in situ" contrary to the old ways of studying on soft muscles. At this Professor Sisson and the audience indulged in laughter. In order to diverge from this "*via arida*" the writer begs the indulgence of his readers while presenting this paper dealing with the veterinary work on horses ranging from 100 in the summer to 250 in the winter, belonging to the Nichols Chisolm Lumber Co.

In the lumber camps and yards the horses not only discharged their ordinary duties but sometimes were also used in road construction. The writer had contracted for this veterinary work with the general manager of the firm in June 1915. A summary of the work is the object of this paper. The first work done was dentistry. After having the horse's mouth open and held so by the speculum the rasp was laid flat on the last molar, and with a gentle downward pull the sharp points were cut off, that is, those points that affected the tongue or the cheek. This procedure was repeated 2 or 3 times and the file was next used, also gently to

smooth what sharp points were missed by the rasp. Protruding points were cut off with the molar cutters. Prolonged use of file and rasp was avoided.

The next step was to eradicate the itch that affected these horses. Although they were dipped in a warm 4% solution of a dip, the results were unsatisfactory. A salve containing sulphur has given marvelously good results.

Another generalized affection was sore necks and shoulders from misfitting collars. Copper sulphate and zinc sulphate salves greatly helped in those cases.

In previous years these horses were under the care of the barn boss, who is quite a good feeder and a very reliable gentleman. Due to the lack of proper care while these horses were affected with influenza, they developed a chronic cough or a running from the nose. Phylacogens (P. D.) Fowler's solution, belladonna, nux vomica in their proper doses entirely checked these ailments, since these horses are young and their affection not very far developed. The drinking troughs were sprinkled with a few drams of copper sulphate. The hay and oats supply was at times obtained from the Dakotas or Montana. Every time some new hay or new oats were fed to these horses, we had our hands full treating colicky horses. The course of treatment, that greatly helped us in those conditions, was Quitman's colic recipe consisting of salicylic acid ℥ss. and ginger q.s. to fill up a capsule. This was my method of procedure. A dozen or two dozen of these capsules were always handy and the barn boss was instructed to use them in case the veterinarian was out on a call. In some way or another these horses would develop wind colic and also would be unable to void urine. In the latter case, sweet spts. of nitre or turpentine would be used; but I shall not fail to give full credit to the salicylic acid. I am often thankful to Dr. Quitman for his kindness in telling me of this treatment in 1914 when he took me out in his auto to see his cases in Borden's stables in Chicago. This year we are less troubled with colics. Oil meal is being mixed with the oats.

We have never had to contend with a case of tetanus as yet. In my estimation the reason is that every time a horse is wounded, whether by a nail or any other offending object, the wound is cleaned with tincture of iodine followed by the required surgical treatment.

For corns, contracted heels or any inflammatory affection of the hoof requiring softening "white rock hoof packing" was used with quite good results. This is practically a résumé of the veterinary work done on these horses during the summer of 1915.

The northern part of Minnesota is yet richly covered with trees belonging to the coniferae, natural order, which are used for lumber. These trees are mostly the white pine or *Pinus strobus*, the spruce or *Picea excelsa* and the like. The region in which these trees grow is mostly inhabited by Indians. The white men buy the timber from them or if it has been homesteaded by some white people, lumber companies buy the land and timber or the timber alone. From 500 to 800 men are employed to hew down these trees in the winter season, saw them into logs and carry them down to a lake or river. Camps are built which provide shelter for from 50 to 200 men and the camps are 10 or 12 miles apart. It was the duty of the veterinarian to drive from camp to camp, attend the cases and instruct the barn boss what ready-made mixture to use in emergency cases. Each barn was supplied with colic medicine consisting of sweet spirits of nitre, belladonna and nux vomica. Another bottle labelled cough medicine, contained sweet spirits of nitre, syrup, belladonna and tincture of opium. Besides these medicines there was a supply of lysol, tincture of iodin, soap, liniment and a drenching syringe.

On a bright day with a glowing sunlight the woods are very picturesque. Here is a long lake about six miles in length and a curve at the end of it. This is Elbow Lake, a name given by the Indians. While driving on the frozen waters of this lake one sees on both of its shores the great pines on the slope of the banks. In the lake one sees round areas where the water bubbles just as boiling water in a tea-kettle. These are water holes made by underground springs. The Indians are very careful to never cut a track close to where these water holes abound. Through the long drives in the narrow Indian trails one can never fail to enjoy the cool breeze that passes through a thicket of balsams, white pines, Norway pines and the tapering spruces. God and his greatness is revealed to that small creature the miser of all beings: the son of Adam. How long this scenery will last is not difficult to guess, as these trees are being cut down very rapidly.

Throughout the whole winter's work there are about one dozen horses out of 250 head that are destroyed on account of being dis-

abled by a heavy log or from some similar accident. What mostly troubles the horses in the woods are cuts from sharp calks, making very deep wounds; also wounds from snags. The hoofs treading on soft or wet snow become very tender and soft, and thus rendered accessible to penetrating snags which are remnants of some bush cleared out to make a road. These wounds are always treated with tincture of iodine followed by the usual surgical procedure.

ABSTRACTS FROM RECENT LITERATURE

MODIFICATION OF THE TECHNIC OF THE OPERATION FOR PENETRATING STREET NAIL. Dr. Cocu. *Recueil de Médecine Vétérinaire,* Vol. 91, pp. 184-187, 1916.—The operation for penetrating street nail, as described by Nocard involves such mutilation of the plantar cushion as cannot be repaired by the proliferation of the underlying tissues. Almost always a deformation of the plantar surface results, with a change in the anatomical-physiological relations which assure to the horse's foot, the elasticity necessary for normal function.

Later, the retraction of the cicatricial tissue causes a depression which may be very deep and a keratocele may develop in it. The compression exerted on the surface of the cicatricial tissue by this tumor is frequently the point of departure of inflammatory pneumonia. This may be followed by suppuration causing sloughing, which in turn necessitates further surgical treatment.

These accidents are particularly frequent after operations performed on the forefeet of animals doing hard work on city pavements.

It is probable that in order to obviate these inconveniences, Professor Cadiot, in his "Lecons cliniques," edition of 1899, advised the utmost sparing of the body of the plantar cushion.

It seemed to me that it was possible to still further obviate the mutilation by conserving entirely the plantar cushion and limiting the incisions to the aponeurosis.

In January 1915, a horse was brought to me, which gave occasion for a trial. The horse had sustained a deep wound in the "middle zone," caused by a hook such as butchers use for suspending quarters of meat. The hook had been brought to the surface of the road by vehicle traffic.

Although the wound was of recent origin, the leg was not used for support, there was incessant pain, abundant effusion of synovial fluid containing lumps, and rise in temperature. These necessitated immediate surgical treatment, which was done the next day.

I performed the operation on the horse in the standing position, after cocaining the plantar nerves below the pastern joint; the foot was held by an assistant as in shoeing.

The extremity of the limb was disinfected and hemostasis assured by a rubber bandage around the pastern. The sole and frog were carefully pared; I divided the latter into two equal parts by a longitudinal incision which prolonged the central sulcus (middle cleft) of the frog to its apex and cut through the entire thickness of the plantar cushion. With the aid of right and left sage knives I loosened the two halves and detached them from the aponeurosis, beginning at the bottom of the median incision and working toward the right and left lateral lacunae. The two flaps were held in forceps and carefully lifted by an assistant. The plantar aponeurosis thus exposed showed, in its internal half, the large perforation due to the penetration of the point of the hook.

The internal part of the navicular bone was stripped of its cartilaginous covering and had been pitted, near one of its extremities, by the point of the penetrating body.

At this level, the substance of the navicular bone was yellowish, a trifle purulent, and easily penetrable by the curet. It presented, in a word, a condition of early caries. All of this altered part was most carefully curetted away in such fashion as to leave the cartilaginous layer intact.

The two halves of the pyramidal body were then brought together and united at five points by separate sutures, using a Cusco needle and an aluminum bronze wire No. 4/10.

The wound was irrigated with cresol solution, dusted with iodoform, covered with several thicknesses of iodoform gauze and a tight compress of cotton held in place by a light shoe and a sheet iron sole.

Following the operation, conditions did not improve as rapidly as expected. The limb was not used for support, temperature remained in the neighborhood of 39°, the animal was off feed and became emaciated. The pastern and coronet became engorged,

leading to abscess formation, and later, to periostosis, which necessitated firing with loss of service of the animal.

The secondary infection, however, was without influence upon the wound of the operation which healed almost without suppuration. On the fifteenth day, I removed the metal wires which united the two halves of the frog. A cicatrization *per primam* hardly permitted the detection of the original incision.

With regard to the conservation of the frog, the result would have been perfect, were it not for the fact that, not having been used for support, it had become strongly retracted, so that its point hardly passed the sesamoid.

During the early part of March, the wound was entirely cicatrized and covered with horn on the entire surface; slowly the frog recovered its normal length and its point attained its anterior limit. However, painful lameness persisted. This, I believe, was due to the coronary periostitis and strong hoof bound condition due to long disuse of the limb. I then used cauterization followed by a vesicant application. On the 28th of April the horse was discharged from the hospital, having completely recovered from the lameness and contracted heels.

To summarize: The three following interesting facts have been brought out: 1. The possibility of performing the operation for penetrating street nail and conserving the frog intact. 2. The immediate reunion of the divided frog is easily obtained. 3. The retraction of the body of the plantar cushion is the operating stumbling block; it causes the separation of the cushion from the adjacent tissues.

In the succeeding operations this trouble was avoided by separating only one of the halves of the frog, leaving the other half fixed in place with its normal anatomical attachments. To facilitate the excision of the flap of the injured fascia, it is separated from the fascia under the fixed half of the frog, with a stroke of a sage knife.

The metal sutures which unite the halves of the frog prevent the detached half from retracting away from the fixed half.

Atrophy of the frog does not result from the above described operation. Healing is obtained in three weeks, that is, less than half the time required when the classical technic is used.

BERG.

THE RELATION OF STABLE AIR TO SANITARY MILK. Abst. from an editorial in the *Jour. of the Amer. Med. Assoc.*, p. 746, Vol. XLVII, No. 10, September 2, 1916.—"For purposes of comparison it may be recalled that Winslow and Browne found that the average number of bacteria per cubic foot (about 28 quarts) of country air was 56, for city street air 72, for offices 94, for factories 113, and for schools 96. Ruehle and Kulp have ascertained that the number of bacteria found in the air of representative stables during such barn operations as milking, feeding hay, grain and the like, usually varies between 50 and 200 per liter (quart) of air, Occasionally much lower results were secured and also a few much higher, the high record being 825 per liter of air. When sterile water was "milked" in a representative stable from an apparatus designed to imitate the exposure of milk in this process in the dairy barn, the germ content of the liquid was found to average 12 per cubic centimeter, with a maximum of 73 and a usual range of from 5 to 15. When the same process was repeated under extreme dusty conditions it was possible to stir up several thousand bacteria per liter of air, so that the water acquired from 30 to 100 organisms per cubic centimeter. Milking under the worst of these conditions, the experimental observers tell us, would, as shown by the results where an artificial dust was raised, have added from 100 to 1000 or more bacteria per cubic centimeter to the milk. On the other hand, under the conditions usually found in representative stables, the number of bacteria added to milk drawn would have been so few as to be undetectable by known methods of analysis.

"The bacteriologic experts of the New York Experiment Station reviewing the quantitative facts now available on the subject, state that no cases have preconceived ideas regarding the effect of certain factors on the production of clean milk so overruled the results of actual observation as in this case. They add that dairymen and sanitarians who have been interested in the production of clean milk have been as badly misled as have surgeons and physicians. This was only natural because of the way in which our knowledge of air bacteria was developed. Bacteria do occur in the air of cow stables in relatively larger numbers than they do in the air of many other places. Occasionally under exceptionally dusty conditions, the number of bacteria getting into the milk from the air may be approximately as high as the number derived from the udder; but the number so derived under ordinary conditions does

not increase the germ content of the milk to any important extent. Lest there be any misunderstanding, however, we must emphasize again the other highly significant sources of bacterial contamination of milk. The unsterilized milk pail, frequently contributing many thousands of microorganisms per cubic centimeter affords an illustration of one remediable factor among several others beside stable dust." REICHEL.

TREATMENT OF WOUNDS WITH SUGAR. Major Albert Lhoste. *Revue Pathol. Compar.*—1st observation. Two horses with badly broken knees were treated as follows: thorough washing with isotonic solution of chloride of sodium, heated to 40° and used as a mechanical antiseptic. Closed dressing with ordinary powdered sugar, which was left five days. When it was removed the wound was covered with a brownish crust. It was washed as before and then appeared rosy with healthy granulations. Another similar dressing was applied and left for five days. Then the wound was almost filled with granulations; hairs were growing on the border of the wounds. Continuation of the treatment brought recovery in 20 days. A saturated solution was used in the latter days of the treatment.

2d observation.—Horse had a wound on the coronet of the right hind leg. It had a bad appearance and quittor was likely to occur. A solution of permanganate was used for disinfecting and a sugar dressing applied. The results were surprising. Granulations developed rapidly, no suppuration took place notwithstanding the exposure of the wound under the conditions of stabling.

3d observation.—Deep scratches on the left posterior coronet. After thorough washing, a dressing of sugar was applied. On the 5th day the recovery was so far advanced that all lameness disappeared and the wound was almost healed. With salt solution saturated with sugar used as a dressing afterwards, the animal was able to resume work on short notice. LIAUTARD.

A BACTERIOLOGICAL STUDY OF AN EPIDEMIC OF SEPTIC SORE THROAT. C. Krumwiede, Jr. and Eugenia Valentine. *Jour. of Med. Research,* 33 (1915), No. 2, pp. 231-238. *Abst. Experiment Station Record,* Vol. XXXIV, No. 5, April 1916.—An account of an epidemic of septic sore throat in a village of 4,250 inhabitants, was found to have its source in the milk supply coming from a certain dairy.

In a bacteriological study it was demonstrated that infection in milk-borne sore throat is of human and not of bovine origin. It is suggested that "in tracing the source of such an epidemic, the effort should be toward finding cases of sore throat among those engaged in producing the milk, not mastitis in the cow alone. If human streptococci are found in mastitis, they are most likely secondary agents in an already existing inflammation due to bovine strains. The streptococci in different epidemics differ culturally and those similar culturally differ in their immunity reactions. Cultural similarity of strains from man and cattle is insufficient to prove their identity. Cultural identity in every detail or immunological identity is essential." M. J. HARKINS.

PAPILLOMA IN THE BLADDER OF A MARE. Capt. A. S. Leese, A.V.C. *Veterinary Journal.*—Brown mare, trooper, about 10 years old, was purged for what was supposed to be the removal of calculi. She showed bladder irritation by frequent straining and expulsion of a few drops of normal looking urine. Examination through the vagina, revealed the bladder as a solid organ and by urethral manipulation a firm growth was detected. Dilation of the urethra with the animal under chloroform, allowed the introduction of three fingers and showed that the tumor was quite large and the attachment beyond reach. The sphincter of the bladder was incised so as to permit the whole hand to penetrate into the organ, but the base of the growth was so broad that complete removal was impossible. Part of it was extracted, however, and this portion established the papillomatous nature of the growth. The mare was destroyed. The walls of the bladder were much thickened and the growth extended over nearly the whole of the interior.

LIAUTARD.

FURTHER STUDIES OF BIOLOGICAL METHODS FOR THE DIAGNOSIS OF TUBERCULOSIS. J. Bronfenbrenner, M. H. Kahn, J. Rockman, M. Kahn. *Archives of Int. Med.,* April 15, 1916. *Abst. Bulletin of the Nat. Assoc. for the Study and Prev. of Tuberculosis,* Vol. II, September, 1916, No. 12, p. 7.—Further attempts to study the value of biological methods in the diagnosis of tuberculosis led to the following conclusions:

The tuberculin of Besredka gives the best results for the complement deviation test. The reaction seems specific even though

the test is positive in a certain number of clinically non-tuberculous cases. In at least 87% of positive tests fixation was confirmed by the use of one or more preparations other than that of Besredka. Different samples of the tuberculin of Besredka, though apparently identical in the mode of their preparation, may differ among themselves in their specific value. The most striking variation is in the amount of lipins contained in tuberculin. It is necessary to free each sample of tuberculin of all its lipin fraction before using such tuberculin for the complement deviation test. The lipins may be extracted by fat solvents, but the easiest method was found to be that of separation of the protein fraction by precipitation. Precipitation of the antigenic fraction of tuberculin also offers the possibility of using a standard number of units of antigen and thus eliminating variations due to the quantitative differences in specific properties of different samples of tuberculin, without increasing the chance of obtaining lipotropic reactions.

It seems, however, that different samples of tuberculin may vary also quantitatively. The variation rests apparently on the fact of the existence of strain specificity in the antibody. The existence of strain specificity in tuberculosis may explain why the results obtained by different investigators in the complement deviation test for diagnosis of tuberculosis vary so much.

A comparison of the frequency of occurrence of the Weisz reaction and the complement fixation in different stages of the disease, suggests that negative serum findings in the face of the positive Weisz reaction may indicate an unfavorable prognosis.

REICHEL.

LUXATION OF THE FLEXOR PEDIS PERFORATUS TENDON IN A DOG. G. Mayall, M.R.C.V.S.—An Irish terrier was lame in the near hind leg. He had received a recent injury about the point of the hock, which was capped. Seen three days later, after liniment had been applied the dog seemed somewhat better but it was then discovered that the tendon slipped off the point of the hock outwards with a click and the dog then walked lame for a few steps and then moved all right. The point of the hock was still slightly swollen. Soap and iodine liniment was prescribed. Improvement followed after a few days but the dog still continued to carry the leg at various times.

LIAUTARD.

INFERIOR HORIZONTAL HEMIANOPSIA IN THE HORSE. P. Vauthrin. *Revue Générale de Médicine Vétérinaire,* Vol. 25, pp. 246-250, 1916.—Shortly after the first cold nights of November 1915, a horse that had not been sheltered, was brought to our attention. He was troubled with disturbance of vision which was extremely rare, and probably has not yet been described in our veterinary literature.

It was a case of hemianopsia (hemianopia, hemiopia). This word is used in ophthalmology to designate the suppression of the lower visual field and the absence of perception of images formed on the upper half of the retina. The subjects affected can see only those objects situated above a horizontal plane passing through the center of the pupil.

The hemianopsia was complete in this case, that is, there was a symmetrical absence of vision in the entire halves of the visual fields of both eyes.

The subject was an American horse, black, six years, had been to the front for several months and was acclimated.

Symptoms.—The horse moves hesitatingly, staggering and shifting suddenly from one hind limb to the other as is seen in the beginning of azoturia. Conjunctiva a little injected, kidneys very sensitive.

After bleeding 6 liters, and the administration of a purgative, the horse was taken to a nearby stable. It was then that attention was drawn to other symptoms which will be described without further reference to the paraplegia menace which disappeared the next day.

The head is carried high enough; face anxious; fore limbs raised oftener than necessary and they seem to feel their way; they struck the smallest obstacles so that falling seemed almost inevitable. When led to a trough full of water the horse did not see it and did not stop until his fore-limbs touched it. He remained there without drinking until someone plunged his lips into the water. But he saw whatever was at the level of his eyes: he did not walk into walls, he lowered his head on passing through a door. Menacing gestures executed close to his head did not affect him until they passed the inferior palpebral border; the reaction was quick when the finger came near his eyes, even at a distance of 3 or 4 meters and at a man's height.

Brought into a stable without a manger, he did not touch the

hay on the ground before him; but went to it eagerly when it was raised to the level of his eyes, even when it was shown to him at a distance. The influence of the sense of smell seemed to be inadequate or nil. This was not therefore, a case of psychic blindness, i. e., loss of memory of optical images; since merely the sight of hay, of the door of the stable or a watering bucket, were sufficient and he would recognize them.

As with the hay, the horse did not touch oats laid down before him; he would eat them when they were shown to him from a distance, or when he was obliged to lower his head down to them. While eating he assumed a very bizarre and characteristic attitude. He curved his neck and gave it a very oblique direction from in front to the rear and from above downward, in such fashion that the forehead was almost horizontal, the nose posed between the forefeet; behind which the horse would look for hay that had been thrust under his eyes.

Picking up oats and bran was very difficult. The ration was put into a movable manger, somewhat narrow and long enough so that Punch (the horse's name) had one end of it under his eyes while he ate from the other end. He supported the inferior third of his forehead on the bottom of the box and ate in that posture as long as the layer of grain was up to the level of his mouth. When that layer was so thin that only his forehead and nose were buried in the oats, he continued to make mastication movements with his lips in the air for some time before he understood that by slightly shifting his head he would find what his eyes could not see.

Examination of the eyes.—The eyes are limpid, well opened; they present nothing abnormal except a slight injection of the conjunctiva and a slight dilation of the pupils. The elliptical pupils were of the same size in both eyes; at the middle they were 7 to 8 millimeters high. The reflexes were normal. The humors were transparent.

During two days these symptoms remained unchanged, but they subsided rapidly during the days following. The first to disappear was the singular attitude adopted while eating. By the sixth day all seemed to be in order. Two months have passed without a relapse; the recovery may be considered complete.

Diagnosis.—Hemianopsia is without doubt very rare among our animals and would easily escape detection because of the absence of information and ophthalmoscopic lesions. One must de-

pend upon a careful study of the animal's attitudes and the exploration of the visual field. The right or left homonymous hemianopsia in which the right or left halves of the visual fields are affected is easily detected by the carriage of the head aside from the median plane. If the right halves of the retina are insensible to light impressions the head is carried to the right and conversely. This form, which is most common in man, always indicates a lesion in the optic tract behind the chiasma and on the same side as the blinded halves of the retinas. It is also called lateral, to distinquish it from superior or inferior horizontal hemianopsia. With regard to the crossed forms, bitemporal or binasal, and es pecially the quadrant forms in which the retinas are blinded on approximately one-quarter of their surfaces, these remain practically always unsuspected.

(The paper concluded with an interesting discussion of the pathogenesis. The structure of the optic tract, with the results of lesions of the various parts is discussed. Hemianopsia in animals other than the horse is briefly mentioned in Hutyra and Marek's Pathology and Therapeutics of the Diseases of Domestic Animals.)

BERG.

UMBILICAL HERNIA—OPERATION. Arthur Spicer, F.R.C.V.S. *Veterinary Record.*—A yearling filly, foaled all right, showed a week later a hernia which grew to be the size of an orange. Three or four interrupted sutures were applied; but the filly did not do well. The hernia became very large. An operation was necessary and performed by an incision through the skin about three inches from the base of the enlargement. Numerous varicose veins were present and bled freely. The dissection of the skin was rather difficult. The abdominal muscles were divided. The bowels were found adherent to the bottom of the sac and demanded careful dissection. A portion of the abdominal muscles had to be excised. The hernia was reduced. Six supporting sutures were put in place, passing through the skin and abdominal walls. The abdominal muscles were sewn up, then the skin and finally the supporting sutures were brought together and tied. The operation took two and three-quarter hours, fourteen and one-half ounces of chloroform being used. The case did well, the temperature varying between 103° and 104.5° the first week and then dropping to normal. The in-

terrupted sutures were removed on the seventh day. Recovery was perfect, leaving only a slight bulging of the skin which will disappear as the filly grows. LIAUTARD.

VACCINATION OF SHEEP AGAINST THE DISEASE SEPTICEMIA PLURIFORMIS OVIUM. H. Raebiger and A. Spiegel. (*Deutsche Tierärztliche Wochenschrift*, Year 23, No. 47, pp. 406-409, Nov. 20, 1915.) Abst.—*International Rev. of the Science and Practice of Agric.* Year VII, No. 1, January 1916, p. 100.—In their experiments with the vaccination of sheep, begun in 1912, against Septicemia pluriformis ovium, the writers have employed a serum which they prepared by means of inoculating 3 sheep with virulent strains of *Bacillus ovisepticus*. For the purpose of trial, white mice suffering from the disease were injected with 0.2 and 0.3 c.c. of the serum. The treated mice survived while those that remained unvaccinated, invariably succumbed. The serum was thus positive in action.

The veterinary practicians who forwarded their reports to the writers had vaccinated 3230 sheep (13 flocks) of which 2804 were healthy, 250 diseased, and 176 doubtful; 867 animals were left unvaccinated as controls. The observations made may be summarized as follows:

Previous to vaccination, in 11 flocks (no report was sent in for 2 flocks) the mortality was 9 per cent. After vaccination, among 3230 animals, the mortality was 3.7 per cent or a reduction of 5.3 per cent. There were, however, among these sheep previous to vaccination 250 diseased animals of which 138 were slightly, and 112 severely attacked. The percentage diseased was thus 7.7 per cent. or almost equal to the percentage of mortality. Of these 250 animals 50 per cent. died after vaccination. In other words, 250 representing 7.7 per cent of the total, the number of sheep saved by vaccination was 3.8 per cent. Had these 7.7 per cent not been vaccinated the percentage mortality would have been 9+7.7=16 per cent. By means of vaccination the lives of 5.3+3.8=9.1 per cent were saved. The mortality was thus reduced by 50 per cent.

M. J. HARKINS.

CALCULI IN KIDNEY AND BLADDER OF A BITCH. President W. R. Davis. *Veterinary News.*—This is from a meeting of the Central Veterinary Society. In making the presentation, the author

remarked that such cases are rather common and that he was induced to relate it because he had made a mistake in the diagnosis. The bitch had been ailing for nine months, showing at times inappetence and vomiting. Then she seemed to be all right but passed fetid and bloody material from the vulva. She was a fox terrier, very vicious and difficult to handle. Finally when she could be secured an examination was made and an enlargement within the abdominal cavity was detected. A diagnosis of chronic catarrh of the uterus was made. The owner declining to have the abdomen opened for more precision in the diagnosis, the dog was destroyed. At post-mortem the uterus was found normal but the bladder was enormously enlarged and distended with innumerable calculi, some as large as a walnut and hundreds of various sizes from a pea to a pinhead. The right kidney also contained several calculi.

LIAUTARD.

FRACTURE OF THE 7TH CERVICAL VERTEBRA. Mr. Willett. *Veterinary News.*—At a meeting of the Central Veterinary Society held in London, the author reported the following. Called one morning on being told that a horse had met with an accident in the riding school, where he was being trained and, when instead of taking the jump, the animal rushed and fell on his head. He was gotten up, walked two or three yards and went down again. Helped on his legs again, he walked a few steps and then fell. He was dragged to his box, attempts were made to put him in slings but he struggled so much that he had to be left lying down. The next day the horse was still unable to rise but fed well, had a normal temperature and a good pulse. Careful manipulation of the neck failed to detect any fracture. The horse was destroyed. On examination of the neck it was found that the seventh cervical vertebra had been broken into thirteen pieces; the sixth had a piece off the wing and the fifth was also broken.

LIAUTARD.

Dr. J. E. Cloud, veterinary inspector, has been placed in charge of B. A. I. work at San Diego, California, vice Dr. MacKellar transferred to tick eradication in Georgia.

ASSOCIATION MEETINGS

AMERICAN VETERINARY MEDICAL ASSOCIATION

REPORT OF THE COMMITTEE ON RESOLUTIONS

"The Finance Committee, in view of the fact that the A.V.M.A. has now attained a membership of huge proportions and has acquired the *Journal* of the A.V.M.A., all of which means that a large sum of money will be collected and disbursed annually, and in view of the fact that vouchers, books, etc., of the secretary, the treasurer and of the *Journal* should be carefully audited each year, we offer the following:

"*Resolved*: That a certified public accountant be employed each year by the committee on finance to audit the books of, and report on the condition of the A.V.M.A.

"*Whereas,* in view of the fact that in many instances vouchers are not receipted and returned by recipient of checks, be it,

"*Resolved*: That a voucher check be adopted by the A.V.M.A."

"*Whereas,* it appears that certain county agents employed in agricultural communities have become active in performing work which properly belongs to the province of practicing veterinarians, be it,

"*Resolved*: That this association regrets the activity in this line displayed by some county agents in certain states. It is the sense of this association that such activities are not conducive to the best interests of agriculture nor to the prosperity of the growers of livestock; that the activities of these agents should be confined solely to educational channels, as it is absolutely unsatisfactory for them to engage in the treatment of diseases of domestic animals, thereby depriving the veterinary practitioner of his legitimate source of livelihood, and be it further

"*Resolved*: That a copy of this resolution be forwarded to the Honorable Secretary of Agriculture by the secretary of this association."

Resolved: That the following letter be commended and transmitted to the Honorable Secretary of War, Washington, D. C. The American Veterinary Medical Association in session at Detroit,

Michigan, August 21–25, 1916, respectfully calls to your attention the following facts:

"It is a matter of common knowledge that the stock of horses on which this country would have to depend in large part in the event of our being involved in a war is being seriously depleted by the purchase and shipment of the most desirable cavalry and artillery types to Europe. The Horse Boards of England, France, Italy and Greece are buying and shipping geldings and mares alike. This shipment of large numbers of mares naturally cuts down very considerably the amount of breeding stock available for the future production of remounts in this country. With the decrease in the number of geldings available for purchase, owing to the great demand and large shipments, the proportion of mares shipped must increase.

"Already it has become very difficult to secure serviceable horses for the regular army and militia service and in the Southwest it is out of the question to buy the really desirable type as the amounts offered for the purchase of individual horses are not enough to meet the bids of the buyers of the foreign governments.

"It is the opinion of this association that this is a situation which is already a handicap to our army and which could be converted into a serious menace by international complications such as have threatened this country a number of times in the past two years. To meet this situation there are two things which this association would respectfully bring to your attention.

"One suggestion is that the United States Government meet the prices of foreign buyers in purchasing horses. It is not to be expected that owners of horses will sell them to the government at a sacrifice in preference to selling them to foreign buyers at a profit. Not only a regard for the best interests of the country, but good business judgment should indicate that when suitable remounts command increased prices, those prices should be authorized and paid rather than permit the purchase of unsuitable and inferior types of animals.

"Another suggestion is that the purchase of mares be authorized. The old objection that they could not be kept owing to the presence of stallions, the property of officers, no longer applies as the use of stallions is not permitted. It is the opinion of the army and militia officers in general that mares are as desirable animals, and polo players regard them as perhaps superior in endurance and

perception. All of the foreign armies use mares. A new French contract now being filled, calls for 25,000 horses, of which 20% to 30% shall be mares. At Ft. Riley 40% of the remounts are mares and in the army polo organizations 60% of the ponies are mares.

"We have the precedent of the purchase of mares for the Native Cuban Cavalry by Q. M. Gen. Luddington during the Spanish-American War on the grounds that these animals would be of more value to them at the close of the war in re-stocking the country with horses. At the close of the present European War, unquestionably many of the mares now leaving this country will be sent to the farms as were the mounts of the Cuban Cavalry and those of the American armies at the close of the Civil War. There could be no objection to this if it were not that the removal of the pick of the American Cavalry horses is already so extreme as to threaten us with serious consequences if our army should need them any time in the next few years. A fresh crop of horses can no more be produced out of hand on demand than can trained soldiers be so produced.

"In view of the above facts, this association respectfully commends to your attention the desirability of having this Government meet the competition of foreign buyers in purchasing suitable animals for our own army, and of purchasing mares in order to increase the present too restricted field of purchase and to retain them in this country for the possible needs of future breeding operations."

"*Whereas,* the livestock interests of the country have been threatened by the ravages of the dreaded foot-and-mouth disease, and

"*Whereas,* the great and efficient work of the federal and state authorities in completely eradicating the infection of the disease from the entire country in such a comparatively short space of time, therefore, be it

"*Resolved*: That this association desires to go on record in highly commending the great services to the country of the national and state authorities in the accomplishment of such a monumental piece of livestock sanitary work."

"*Whereas,* division and discord have existed in the ranks of the veterinary profession in the states of Wisconsin and Oklahoma, and

"*Whereas,* these differences have been satisfactorily adjusted and harmonious reunion of broken ranks effected,

"*Resolved*: That the American Veterinary Medical Association learns with pleasure that the veterinary profession of Wisconsin and of Oklahoma presents perfect fraternal solidarity."

"*Resolved*: That this association hereby express its appreciation of the entertainment furnished the members and visitors at this meeting by Parke, Davis & Company."

"*Resolved*: That this association hereby express its appreciation of, and tender its thanks to the local committee of arrangements for their sucessful efforts in providing entertainment for this meeting."

"The Special Committee on Advertisements of Veterinary Remedies, recommends that the following resolution be adopted, by this association:

"*Resolved*: That misleading claims for biological products should not be tolerated by this association, and any official of any firm or corporation who is a member of this association and allows such claims to be made, the same shall be sufficient reason for rejection or expulsion from this association; and this association should accept the federal regulations governing biological products as a standard of applicaion."

JOHN W. ADAMS, *Chairman*
L. FROTHINGHAM
GEORGE R. WHITE
GEORGE H. GLOVER
JOHN L. WHITE

REPORT OF THE COMMITTEE ON REORGANIZATION

CONSTITUTION

ARTICLE I.

Section 1. This organization shall be known as the AMERICAN VETERINARY MEDICAL ASSOCIATION.

Article II.

Objects

Section 1. The objects of this association are:

(a) To protect and promote the professional interests of the veterinarian.

(b) To elevate the standard of veterinary education.

(c) To procure the enactment and the enforcement of uniform laws and regulations relative to veterinary practice and the control of animal disease.

(d) To direct public opinion regarding problems of animal hygiene.

(e) To promote good fellowship in the profession.

Article III.

Members

Section 1. Membership in this association shall be of two kinds—Active and Honorary.

Active Members

Section 2. Active members must be graduates of veterinary colleges approved by the association and recommended by the Executive Board and elected to membership in accordance with the By-laws.

A member who has been in good and regular standing for twenty-five years, shall receive the title of Fellow of the American Veterinary Medical Association. A certificate of such fellowship shall be issued by the secretary.

Honorary Members

Section 3. Honorary membership may be conferred upon any person resident in any part of the world, who has rendered valuable service to Veterinary Science. A person presented for Honorary Membership must be recommended by the Committee on Intelligence and Education, and elected by three-fourths majority vote of the active members present at a regular meeting. They shall have all the privileges of active members, except that they shall not pay dues, hold office nor vote, nor have any right or title to or interest in any real or personal property of the association. Not more than three Honorary Members shall be elected in one year.

Article IV.

Meetings

Section 1. Meetings of the association shall be regular and special. The regular meeting shall be held annually. It shall be convened not earlier than July 15th, nor later than the 31st of December of each year, unless otherwise ordered by a two-thirds vote of the members of the association, and notice of the selection shall be given to each member by the secretary at least sixty days before the date of the meeting, or at such time as may be designated by a special election held in accordance with the By-laws.

The time, place and duration of the regular meeting shall be fixed by the Executive Board unless otherwise ordered by the association at a regular meeting. Special meetings may be called by the President upon request in writing of not less than 200 active members. The time, place and purpose of special meetings shall be designated in the call.

Article V.

Officers

Section 1. The officers of the association shall consist of a President, Five Vice-Presidents, a Secretary, a Treasurer, and an Executive Board. They shall be elected at the regular annual meeting, and hold office, except the Executive Board, for one year from the date of their election, or until their successors are elected and have assumed office. No person shall be eligible to the office of the President, Vice-President, Secretary or Treasurer unless he has been a member in good standing for the five years preceding his election.

President

Section 2. The President shall preside at all meetings of the association. At the regular annual meeting he shall be expected to deliver a short address. The President shall appoint members of committees and all officers whose appointments are not otherwise provided for; he shall perform such other duties as ordinarily devolve upon a president. He shall not be eligible for re-election.

Vice-Presidents

Section 3. In case of death or resignation of the President, or in case of his inability to perform the duties of his office from any cause, the same shall devolve upon the Vice-President in sen-

iority for the remainder of the unexpired term, or until the disability be removed.

SECRETARY

Section 4. The Secretary shall perform all the clerical duties of the association, and be custodian of all its property except money, and the properties of the official Journal office. All moneys received by him shall be paid monthly to the Treasurer. He shall receive such salary and allowance as may be recommended by the Executive Board and approved by the association.

He shall give bond to the association in the sum of five thousand dollars ($5,000), to be approved by the Executive Board. He shall present a written report at the regular annual meeting.

TREASURER

Section 5. The Treasurer shall account to the association for all moneys received. He shall give bond to the association in the sum of ten thousand dollars ($10,000), approved by the Executive Board. At the expiration of his term of office he shall account for and turn over to his successor in office all moneys, vouchers and account books belonging to the association.

The Treasurer shall pay out moneys only on vouchers countersigned by the President and Secretary, excepting minor expenses of the Secretary, and such revolving fund allowance as may be placed at the disposal of the Editor and Manager of the "Journal" by the Budget Committee.

The treasurer shall at the regular annual meeting present a written detailed statement with vouchers covering all receipts and expenditures.

PROPERTIES

Section 6. All officers shall, at the expiration of their terms of office, turn over all property of the association to their successors.

EXECUTIVE BOARD

Section 7. The Executive Board shall consist of five members, one from each Executive Board district and one member at large and it shall elect annually its own chairman.

Each member of the Executive Board shall hold office for five years, except the district members first elected under this Constition. Those first elected from the First, Second, Third, Fourth and Fifth Districts shall hold office respectively for One, Two, Three, Four and Five Years from the date of the election.

The Executive Board shall constitute the Administrative Body of the association, and shall make all necessary regulations for carrying into effect the provisions of this Constitution and the By-Laws.

Unless otherwise provided for, the Executive Board shall select the time, duration and place for holding the annual meetings, and shall make necessary arrangements therefor.

The Executive Board shall pass upon the eligibility of all candidates for membership and report their recommendations to the association. Four members of the Executive Board shall constitute a quorum for the transaction of business.

The Executive Board shall act upon and report promptly on all recommendations of the President of the association and resolutions or other matters duly referred to them by the association, or sections thereof.

On the written request of at least one hundred members of the association, the Executive Board shall submit any question to the whole membership for decision by mail ballot. All ballots returned to the Secretary shall be signed by the active members voting and said ballots shall be retained by the secretary for at least two years after they have been counted. All mail ballots on specific questions, nominations and elections shall be of the same date and issue. Ballots not signed, and ballots not returned within sixty days after date of issue, shall not be counted.

Accurate records shall be kept by the Secretary of the association of all meetings of the Executive Board.

A summary of such records shall be published in the proceedings and distributed to the members, except when the Executive Board deems it for the best interests of the association to temporarily withhold from such publication and distribution such records or any part thereof.

Itemized accounts of all disbursements, with the purpose thereof and records of votes shall never be withheld from publication.

The Executive Board shall have full discretion to withhold from the "Journal" in whole or in part any paper or part of proceedings that may be referred to the Board by the association or by the editor.

It shall be the duty of the Executive Board to consider and recommend yearly to the association concerning the selection of an Editor and Business Manager of the "Journal" of the American

Veterinary Medical Association. The Editor and Business Manager of the said "Journal" shall receive such salary and allowances as may be recommended by the Executive Board and approved by the association.

The Executive Board shall have the "Journal" accounts audited by a qualified accountant annually or oftener if deemed necessary, and submit annually to the association a financial statement including inventory.

The Executive Board shall be vested with power to hear all complaints filed before it in writing relative to the improper conduct of any member, and shall if thought advisable, summon the member so charged to appear before it at the next annual meeting of the association, to answer the charges and make defense. If the Board find the defendant guilty as charged, said Executive Board shall report at once to the association a summary of the charges and evidence submitted on both sides, together with such recommendations as may be deemed wise; but no public report of such charges or evidence shall be made by the Board or any member thereof until after trial by the Executive Board.

Executive Board Districts

Section 8. There shall be five Executive Board Districts as follows:

District No. 1 shall consist of Canada.

District No. 2 shall consist of Wisconsin, Illinois, Michigan, Indiana, Ohio, Pennsylvania, New York, the New England States, New Jersey and Delaware.

District No. 3 shall consist of Kentucky, West Virginia, Virginia, Maryland, District of Columbia, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Florida, Cuba, South America.

District No. 4 shall consist of Alaska, Washington, Montana, North and South Dakota, Minnesota, Iowa, Nebraska, Wyoming, Idaho, Oregon, Philippines, and Hawaii.

District No. 5 shall consist of California, Nevada, Utah, Colorado, Kansas, Missouri, Arkansas, Oklahoma, Louisiana, Texas, New Mexico, Arizona, Mexico, and Central America.

Vacancies and Removals

Section 9. The President shall fill any vacancies in the Executive Board from the district in which such vacancy occurs, and said

appointee shall hold office until a special election of the district may be held.

If a member of the Executive Board removes from his district, such removal shall automatically cause a vacancy.

Vacancies in the office of Secretary or Treasurer shall be filled by appointment for the unexpired term by the President.

The Executive Board may for dishonesty or incompetence, remove the Secretary or Treasurer from office upon approval of the President.

Executive Board Meetings

Section 10. The Executive Board shall hold its regular session at the time and place of the annual meeting of the association. Special meetings may be called by the Secretary upon written request of 5 members of the Executive Board.

Article VI.

Any amendments to this Constitution shall be proposed in writing at an annual meeting, but shall not be acted upon until the next following annual meeting, nor shall it be adopted finally except by the votes of at least two-thirds of the members present and voting.

BY-LAWS.

Article 1.

Order of Business

Section 1. The following shall be the order of business, except as otherwise provided:

1. Call to order by the President.
2. President's address.
3. Presentation and adoption of minutes.
4. Report of the Executive Board.
5. Admission of New Members.
6. Election of Officers.
7. Reports of Officers.
8. Reports of Committees.
9. Unfinished Business.
10. New Business.
11. Installation of Officers.

Section 2. All meetings of the association shall be governed by Roberts' Rules of Order when not in conflict with the By-Laws.

Article 2.

Application for Membership

Section 1. Application for membership in the association shall be made on blank forms approved by the Executive Board. The application blanks filled out and signed by the applicant in his own hand writing shall be mailed or delivered to the Secretary, who shall present the same to the Executive Board for final action. An application to be considered must have been endorsed by two members in good standing, one of whom shall be a resident of his own state and must be accompanied by the membership fee and one year's dues. If the applicant is a practitioner he shall have satisfied the legal requirements for practice in the state in which he resides.

Section 2. Except as provided in Sections 3, 4, and 5, of this Article, only those veterinarians may be admitted to active membership who have spent not less than three collegiate years in the study of veterinary medicine and have been duly graduated from an accredited veterinary college conforming to the requirements of regulations 1 to 19 inclusive of Bureau of Animal Industry, Circular No. 150, as printed on pages 175 to 182 of Proceedings of the forty-ninth annual meeting of the A. V. M. A., 1912.

Section 3. A graduate of a veterinary college which, at the time of his graduation, did not maintain an educational standard in conformity with the active membership requirements of this association, may upon recommendation of the Executive Board, be elected to membership, provided he has been duly graduated not less than five years prior to the date of application, and further, that the college has ceased to graduate veterinarians contrary to the standards now fixed by this association.

Section 4. Except as provided for in Section 3, only those veterinarians may be elected to active membership who have spent not less than 28 months in not less than four collegiate years in the study of veterinary medicine, beginning with the session 1916-1917, and have been duly graduated from an approved veterinary college.

Section 5. The matriculation requirements of an approved veterinary college. beginning with the collegiate year 1914-1915, shall be one year of high school work or equivalent studies taken in other preparatory schools. Beginning with the collegiate year 1918-1919, said requirements shall be two years of high school work or equivalent studies taken in other preparatory schools.

Section 6. All candidates for membership favorably reported to the association by the Executive Board, shall be balloted upon and a three-fourths vote in the applicant's favor will entitle him to active membership.

ARTICLE 3.

Section 1. Notice of the time and place of holding the regular meeting shall be announced at least three months before the date fixed for the meeting.

Section 2. Notice of the time and place of holding a special or adjourned meeting shall be mailed to each active member at least twenty days before the date fixed for the meeting. No business shall be transacted at special meetings which was not clearly and definitely stated in the call convening such meeting.

Section 3. The general sessions of the association shall be held at 2:00 P. M. each day, except the first. On the first day of the annual meeting there shall be a session at 10:00 A. M.

The sections of the association shall hold their meetings at 9:00 A. M. each day, except the first day, when they shall convene at 2:00 P. M. Night sessions may be convened by consent of the membership of any section.

ARTICLE 4.

QUORUM

Section 1. Twenty-five percent of the members of the association registered at any meeting shall constitute a quorum for the transaction of business.

ARTICLE 5.

DUES

Section 1. There shall be an initiation fee of five ($5.00) dollars. The annual dues shall be five ($5.00) dollars, payable in advance on the first day of January. Honorary members shall pay no dues.

ARTICLE 6.

DELINQUENCY

Section 1. Any member who for two years fails to pay his annual dues shall forfeit his membership thirty days after notification from the Secretary has been mailed to his last known address.

ARTICLE 7.

REINSTATEMENT

Section 1. A member who has forfeited his membership for non-payment of dues, may be reinstated by the Executive Board upon payment of his entire indebtedness to the association.

Section 2. A member who loses his membership for a reason other than non-payment of dues may be reinstated only by application as in the case of new members.

ARTICLE 8.

NOMINATIONS

Section 1. Nominations for office, except as otherwise provided for shall be made orally. A nominating speech shall not exceed two minutes and the nominations shall not be closed until every member present has had an opportunity to present his candidate.

ARTICLE 9.

ELECTION OF OFFICERS

Section 1. A majority of all the votes cast shall be necessary to elect. If no nominee receives a majority of the votes on the first ballot, the nominee who receives the lowest number of votes shall be dropped and a new ballot shall be taken, and so on until a nominee receives a majority.

Section 2. The officers of the association shall be elected at the afternoon session the second day of the annual meeting.

ARTICLE 10.

ELECTION OF MEMBERS OF EXECUTIVE BOARD

Section 1. Six months before the annual meeting at which a member of the Executive Board is to be elected, the Secretary of the association shall send to each member in that district a statement that a member of the Executive Board is to be elected and ask for a nomination to be sent to the Secretary at least four months before the annual meeting. The Secretary shall make a list of the names of the highest five, who shall constitute the nominees for membership on the Executive Board in that district. Each member of the district must send his ballot for the nominee of his choice to the Secretary two months before the annual meeting. The nominee shall be voted upon by mail ballot. A plurality only shall be necessary to a choice. In case of a tie the members from the district attending the annual meeting shall decide by ballot at a meeting of the members from the district called by the President.

The member at large shall be elected by ballot at the regular annual meeting.

ARTICLE 11.

INSTALLATION

Section 1. The officers of the association shall assume their duties at the close of the annual meeting at which they are elected.

ARTICLE 12.

SECTIONS

Section 1. The association shall be divided into the following sections:

A. Practice and Surgery.

B. Sanitary Science and Police.

C. Veterinary Colleges and Examining Boards.

The Executive Board may make additional sections as deemed expedient.

SECTION OFFICERS

Section 2. The officers of each section shall consist of a chairman and a secretary. They shall be elected by the members of the section. They shall serve one year and until their successors are elected and have assumed office.

CHAIRMAN OF SECTION

Section 3. The chairman shall preside at all meetings of the section and shall perform the usual duties belonging to such office. He shall co-operate with the Secretary of the section in arranging the program and shall see that proper arrangements have been made for the carrying out of the same.

SECRETARY OF SECTION

Section 4. The secretary shall keep an accurate record of the proceedings of the section. He shall, in co-operation with the Chairman, arrange the program of the section for the annual meeting. He shall send the program to the Secretary of the association at least forty days before the annual meeting for insertion in the program of the association.

LENGTH OF PAPERS

Section 5. A maximum of twenty minutes will be allowed for the presentation of a paper, and five minutes for each speaker taking part in a discussion. The author will be allowed a reply to questions and criticisms at the end of the discussion.

PAPERS READ BY TITLE

Section 6. No paper shall be published as having been read before a section unless it has actually been read, or unless the section shall vote to have it read by title.

PROPERTY IN PAPERS

Section 7. All papers and reports of any nature presented to the Association or to any section shall be the property of the association, if approved for publication. Consent from the Execu-

tive Board must first be obtained to permit the author of any paper to publish his paper prior to its publication in the official Journal.

Article 13.

Editor and Business Manager

Section 1. The Editor and Business Manager, which positions may be held by the same individual shall perform the usual duties of such positions in connection with the official organ of the association.

The Journal of the American Veterinary Medical Association shall publish the proceedings, transactions, papers, etc., and such other matters as the editor may select.

Article 14.

Invited Guests

Persons not eligible to membership in the association may be invited by any member to attend the annual meeting of the association, or the meetings of a section.

Article 15.

Registration

Section 1. No member may vote at a regular meeting until he has registered and paid his entire indebtedness to the association.

Article 16.

Honorary Members

Section 1. Nominations for honorary membership shall be made in writing and submitted to the association not later than the second day of the annual meeting. An interval of at least twenty-four hours shall edapse between the nomination and the election.

Article 17.

Standing Committees

Section 1. There shall be the following Standing Committees consisting of five members each except as otherwise provided:

1. Budget.
2. Intelligence and Education.
3. Legislation.
4. Necrology.
5. Resolution.
6. Audit.

The Committee on Budget shall consist of the President, Secretary, Treasurer and Chairman of the Executive Board. It shall

be the duty of the committee to consider the financial resources of the association and proposed expenditures. This committee shall report its recommendations to the association for ratification before the close of the meeting.

The Committee on Intelligence and Education shall consist of five members to be appointed by the President to serve for a period of five years, except at the outset one member shall be appointed for a period of one year, one for two years, one for three years, one for four years, and one for five years. This committee shall elect annually its own chairman. It shall be the duty of the committee to report annually upon the progress and needs of veterinary education. It shall inspect veterinary colleges as it may deem necessary or as directed by the association; and shall annually recommend a list of veterinary colleges for recognition by the association.

The Committee on Legislation shall consist of five members to be appointed in the same way and for the same terms as the Committee on Intelligence and Education.

Article 18.

Resident Secretaries

Section 1. Each state, territory, province or country may have a Resident Secretary appointed by the President.

Section 2. Each Resident Secretary shall co-operate with the Committee on Intelligence and Education and shall aid the President and Secretary in such a manner as they may direct.

Article 19.

Ethics

Section 1. Members of this association are expected to conduct themselves at all times as professional gentlemen. Any flagrant violation of this principle shall be considered by this association as unprofessional conduct, and on written charges filed with the Executive Board, may subject the violator to suspension or expulsion as provided in Article 5, Section 7, of the Constitution.

Article 20.

Amendment to By-Laws

Section 1. The By-Laws of this association may be amended at any annual meeting by the same procedure as provided for amending the Constitution.

Section 2. The By-Laws may be suspended temporarily by

a vote of three-fourths majority, but such suspension shall not apply to Section 1, Article 19, and Section 1, Article 20.

Section 3. Officers elected under the old Constitution and By-Laws shall constitute the first set of officers under the new organization in so far as provided for in the new Constitution and By-Laws.

Section 4. The Secretary of the association shall proceed at once to take the necessary steps for the nomination and election of the Executive Board as provided in Section 1, of Article 10, of the By-Laws.

C. A. CARY, Chairman.
TAIT BUTLER,
M. H. REYNOLDS,
JOHN BLATTENBERG,
P. A. FISH,
Committee on Reorganization.

REPORT OF THE COMMITTEE ON THE SALMON MEMORIAL FUND

DR. J. F. WINCHESTER AND DR. W. HORACE HOSKINS

DR. WINCHESTER: Mr. President and Members: At the last meeting in California, as you all know, there was a committee elected to be known as the Salmon Memorial Fund Committee. The object was, or is, to raise money enough, the income from which will be used for a scholarship for somebody to be selected by this association. When that money is raised, probably in the vicinity of $10,000, the activity of this committee ceases.

The money that is received should not, and will not, be used for the expenses of this committee. At the present time what expense we have been put to has been met by us as individuals, and anticipating that this organization would reimburse us for the outlay up to date. There was no vote taken, as I understand it, or on the records that I can read, that the expenses should be met by the association. You do not feel like giving up your money for an object and having that money used by the committee, and I don't feel as though I should be a party to that, and I will not. If the association does not agree to pay the necessary expenses—and they are not large—I for one, will get out. That is the way I feel about it.

The members composing this committee, you can ascertain, by looking at your program. Our friend Hoskins is secretary and treasurer and he has the figures and the data, and there will be an opportunity now for what information he desires to give. I hope this association will, before anything else is done, permit or order the expenses of this committee to be paid, and the bills contracted will be approved by a majority of that committee before being presented to the association for payment.

I have no right to make that motion, and I shall not make it, I trust it will come from the floor before or after Dr. Hoskins and Dr. Rutherford get through talking.

DR. HOSKINS: I did not know that the report of the Salmon Memorial Committee would be called for this afternoon, hence, I did not bring the data along which I have prepared of the work so far done. You will remember that we started out with the hope in the period of three years of raising the sum of at least $10,000 from the veterinary profession of North America. Unfortunately for the committee, so much of my time was taken up along other lines the first six months that we were not able to get the plans in working order as rapidly as we would have liked. Up to this writing we have raised $3,000 or nearly one-third of the amount. We have the work organized in about fifteen different states. At a very late date the secretary of this association sent out instructions to the state secretaries that they would undertake a part of this work in co-operation with the Salmon Memorial Committee, so that within the last three or four months we have been able to invoke the activity of the resident state secretaries in a number of the states.

At the present time New York State leads the amount in subscriptions by something over $300. Pennsylvania follows with about $300, and these amounts go down until they reach the sum of $2 from one state.

Seven different state organizations have appropriated $100 from their treasuries. There has been some little misunderstanding among some of the state organizations that when this money was appropriated it was necessary to turn it over immediately to the Salmon Memorial Committee. As I stated before we planned to get this sum of money, $10,000, in a period of three years, so that state associations which desire to take action need not feel it is incumbent upon them to pay over at once the money that they may appropriate from their treasury. We hope and expect that we will

raise in each of the states of our Union the equivalent of $1 for each veterinarian registered in the state. We believe that the largest number who may contribute to this fund will add very materially to the success and to the purpose of the fund in memorializing in the future profession, as it is fixed today very definitely in the minds of those who are living, the wonderful services of Dr. Salmon, and we trust that when you make your appeals in your state you will make them very forcibly for the very smallest contribution that anyone may see fit to make is just as much desired as a large contribution from those who are well able to give. The value and the force and the purposes of this amount will be enhanced by the great number of small contributions rather than by a limited number of large contributors.

From one source the committee has received an appropriation of $800, and there is a prospect that this amount may reach $5,000 from similar sources, but this is a source outside of the profession, although one which the work of Dr. Salmon made possible, and made great in our country.

I do trust that everyone will interest himself personally in the work of the completion of this fund and co-operate with the committee in making it secure within the next three years, so that the interest of that fund when invested by direction of this association, may be the means of aiding someone through college or may be the means of carrying out some special work so much of which is demanded today, and is visible to our eyes as needing to be done for the profession and that the good work he has done for 25 long years will be perpetuated through this memorial fund to so good a man of our profession. I will file with you tomorrow, as I stated, in typewriting, a form showing the contributions and the amount we have received and also the sources, as well as the expenses that the committee has been put to. I will say up to the present time we have not utilized any money for the expenses that have been incurred for this fund, even to the extent of a dollar.

REPORT OF THE COMMITTEE ON EMBLEM

To the President and Members of the American Veterinary Medical Association,

Gentlemen:

Immediately following the organization of this committee steps were taken to ascertain so far as possible the desires and sentiments of veterinarians throughout the country relative to the adoption of an official emblem by this association.

With this object in view letters were addressed to all resident state secretaries and so far as this committee has been able to obtain an expression of opinion, sentiment is in favor of adopting the blue cross as an official emblem. Several modifications have been suggested, such as a white background, gray background, blue cross set in a red V, etc., but all, with few exceptions, included the blue cross in their designs. Resolutions have been adopted by several state associations either to adopt the blue cross as their emblem or recommending its adoption by this association.

Several individual designs of merit have been submitted; one from Dr. F. A. Crandall, New York, being a circle containing the words *"Fonos habet onus humanum est errare"* in the center of which are the initials A.V.M.A. A suggestion from Dr. H. J. Hammond of California for a combination of the letters A.V.M.A. arranged in a manner similar to the emblem of the A.M.A., thus: AA. Two designs were submitted from Canada which are included with the various designs forwarded to the committee and presented here today. With these four exceptions all designs submitted include the blue cross in some form.

Frequent reference has been made to the blue cross as used by veterinarians in the English Army and this committee has made every effort to gain authentic information relative to insignias being used by veterinarians on the battlefields in European countries. It was learned that the International Alliance of Societies to Aid Animals upon the Battle-Field, organized in Geneva, Switzerland, has adopted as its seal and insignia a Red Star, underneath which are the words *"Inter Arma Misericordia,"* meaning "Mercy Between Arms." The Red Star flag is being used by the Field Veterinary Hospitals of the German and Austrian armies, while on the Franco-British lines the Blue Cross is being used by the London Society for the Prevention of Cruelty to Animals, which we under-

stand, is very active at the front in assisting the British Army Veterinarian.

This information would indicate that both the Red Star and the Blue Cross are being used for identical purposes, the Red Star as the insignia for an International Alliance of Societies, and the Blue Cross for a purely local British Society.

Since the Red Star has already been adopted by an international society and bids fair to parallel the Red Cross in popularity and world-wide usage, your committee believes it would not be a suitable emblem for this association to adopt.

We, as your Committee on Emblem recommend the Blue Cross as an insignia for this association, the cross to be the same shape and of the same proportions as the Clara Barton Cross, either plain or set in a gray or white circular background.

D. M. CAMPBELL,
DAVID S. WHITE,
O. A. LONGLEY, Chairman,
Committee on Emblem.

ATTENDANCE AT THE A.V.M.A., DETROIT, MICH.

MEMBERS

Alabama—C. A. Cary; E. D. King, Jr.; W. W. Webb.

California—R. A. Archibald; P. H. Browning; B. J. Cady; C. M. Haring; G. H. Hart; O. J. Kron; J. F. McKenna.

Colorado—G. H. Glover; I. E. Newsom; C. G. Lamb.

Connecticut—H. E. Bates; T. G. Bland; C. L. Colton; A. T. Gilyard; F. A. Ingram.

Delaware—H. P. Eves.

District of Columbia—D. E. Buckingham; A. Eichhorn; M. C. Hall; F. Hicks; J. R. Mohler; G. M. Potter; J. P. Turner; A. R. Ward.

Georgia—W. M. Burson.

Illinois—A. H. Baker; T. M. Bayler; F. F. Bushnell; D. M. Campbell; L. E. Day; C. G. Glendinning; J. T. Hernsheim; W. L. Hollister, W. B. Holmes; L. B. Huff; Jos. Hughes; J. V. LaCroix; F. J. Leith; A. R. Luzader; G. B. McKillip; A. M. Mair; D. G. Marks, N. S. Mayo; L. A. Merillat; W. R. Michael; W. J. Morgan; J. T. Nattress; E. L. Quitman; Jas. Robertson; J. F. Ryan; H. R. Ryder; W. H. Shaw;

Indiana—R. C. Applegate; W. J. Armour; J. Black; F. A. Bolser; D. K. Buzzard; C. V. Connell; R. A. Craig; W. B. Craig; L. DeMott; L. C. Finley; J. O. Greeson; C. E. Heflich; R. C. Julien; H. J. Kannal; T. F. Kryer, J. W. Klotz; B. H. Largent; A. F. Nelson; C. W. Power; J. D. Reardon; G. H. Roberts; J. C. Rodger; P. Schian; T. A. Sigler; O. G. Whitestone.

Iowa—H. E. Bemis; H. D. Bergman; J. D. Grossman; W. F. Guard; C. H. Hays; S. K. Hazlet; L. R. Himmelberger; G. A. Johnson; L. W. McElyea; P. Malcolm; H. S. Murphey; W. L. Nelson; G. A. Scott; G. M. Williams.

Kansas—J. H. Burt; R. R. Dykstra; L. W. Goss; C. B. Kern; J. E. McCoy; C. J. Sihler.

Kentucky—J. K. Ditto; C. A. Miller; F. O. Schneider.

Louisiana—W. H. Dalrymple; J. L. Drexler; H. Moore.

Maine—W. L. Mebane; W. H. Robinson; H. B. Wescott.

Maryland—G. H. Grapp; G. A. Jarman; T. H. Mackie; C. E. Poe.

Massachusetts—E. A. Cahill; W. H. Dodge; W. J. Hennessy; L. H. Howard; H. Lukes; B. D. Pierce; W. S. Plastell; J. W. Robinson; W. M. Simpson; J. F. Winchester.

Michigan—T. H. Attridge; W. N. Armstrong; C. F. Birmingham; F. M. Blatchford; W. L. Brenton; S. Brenton; S. Brown; H. T. Carpenter; G. H. Carter; E. B. Cavell; F. W. Chamberlain; W. Coxe; W. R. Cox; C. C. Dauber; J. S. Donald; J. Drury; G.W. Dunphy; M. E. Elzinga; G. F. Ewalt; W. A. Ewalt, G. D. Gibson; W. Giltner; H. M. Gohn; E. Hallman; W. Hansen; J. Hawkins; F. H. Hicks; H. P. Hoskins; J. P. Hutton; S. Irwin; J. J. Joy; T. F. Krey; R. P. Lyman; J. S. McDaniel; A. McGercher; L. A. Maze; M. H. Mendenhall; C. C. Mix; A. H. Moody; C. L. Osgood, H. F. Palmer; E. E. Patterson; R. D. Rice; E. P. Schaffter; H. L. Schuh; A. B. Sexmith; M. J. Smead; F. A. Spach; H. E. States; C. C. Stevens; H. Stevens; B. H. VanBrussel; C. A. Waldron; J. E. Ward; J. C. Whitney; R. H. Wilson.

Minnesota—W. L. Beebe; S. D. Brimhall; C. E. Cotton; M. H. Reynolds; C. S. Shore; S. H. Ward; M. S. Whitcomb.

Mississippi—W. L. Gates; O. M. Norton; F. L. Parse; E. M. Ranck.

Missouri—F. M. Cahill; J. W. Connaway; J. G. Eagle; H. Jensen; A. T. Kinsley; F. C. McCurdy; R. C. Moore; C. J. Norden; C. E. Salsbery; J. H. Slater; S. Stewart.

Nebraska—J. S. Anderson; A. A. Munn.

Nevada—H. W. Jakeman.

New Hampshire—A. L. Edmunds; S. T. Law; C. E. Swail.

New Jersey—L. D. Horner; W. Runge; G. B. Vliet.

New York—G. H. Berns; R. R. Birch; W. R. Blair; R. G. Bose; D. B. Comstock; D. W. Cochran; J. F. DeVine; R. W. Ellis; O. Faust; P. A. Fish; C. P. Fitch; E. W. Fitch; F. D. Fordham; J. N. Frost; C. E. Hayden; W. G. Hollingworth; F. Hunt; W. H. Kelly; W. W. Kennedy; R. F. Knight; F. E. McClelland; J. A. McCrank; W. J. McKinney; H. D. Martin; H. J. Milks; V. A. Moore; C. R. Perkins; E. Rafter; E. Sunderville; D. H. Udall; P. V. Weaver; H. E. Wende; J. L. Wilder; W. L. Williams; J. G. Wills.

North Carolina—J. I. Handley; G. A. Roberts.

Ohio—F. E. Anderson; W. A. Axby; N. D. Backus; J. E. Bard; R. I. Benath; G. Biddle; J. H. Blattenberg; W. A. Brown; S. Burrows; C. H. Case; W. E. Clemmons; G. W. Cliffe; A. S. Cooley; A. E. Cunningham; E. A. Downs; B. H. Edgington; J. D. Fair; P. Fischer; C. W. Fogle; C. B. Frederick; G. L. Frese; H. Fulstow; J. P. Gardner; P. T. Gillis; B. W. Groff; J. T. Gruber; C. G. Hershey; R. C. Hill; R. Hilty; E. R. Hinkley; M. W. Howett; A. J. Kline; W. E. Kreeder; J. H. Lenfestey; H. E. Myers; J. V.

Newton; H. B. Ropp; W. H. Redhead; E. J. Renter; R. C. Roueche; C. H. Sater; W. Shaw; E. H. Shepard; C. D. Turney; W. B. Washburn, D. S. White; W. F. Wise.

Oklahoma—G. T. Cole; R. F. Eagle.

Oregon—B. F. Simms.

Pennsylvania—J. W. Adams; E. P. Althouse; E. L. Cornman; H. B. Cox; G. A. Dick; D. B. Fitzpatrick; J. B. Hardenbergh; J. Helmer; W. H. Hoskins; L. A. Klein; G. C. McLean; C. J. Marshall; I, Mitterling; T. E. Munce; O. G. Noack; E. C. Porter; J. Reichel; W. L. Roswell; C. A. Schaefer; F. H. Schneider; H. W. Turner; F. Weitzel; W. E. Wight.

Rhode Island—J. M. Armstrong; T. E. Robinson.

South Carolina—F. P. Caughman.

South Dakota—G. A. Edmiston.

Tennessee—Tait Butler; M. Jacob.

Texas—F. E. Barnes; B. O. Bethell; R. C. Dunn.

Vermont—E. H. Bancroft; G. R. Welch.

West Virginia—J. J. Cranwell; C. L. Hall; S. E. Hershey; H. B. Langdon.

Wisconsin—A. E. Behnke; F. E. Burnham; B. L. Clarke; L. S. Crump; H. F. Eckert; O. H. Eliason; T. H. Ferguson; H. Greeder; F. B. Hadley; A. N. Lawton; H. D. Pattison; J. F. Raub; W. A. Wolcott; L. A. Wright.

Wyoming—S. V. Lewis; H. R. Millard.

CANADA. *Alberta*—J. G. Rutherford.

British Columbia—S. Hadwen, C. D. McGilvray.

Manitoba—J. A. Stevenson.

New Brunswick—L. S. Doyle; D. McCuaig.

Ontario—W. J. R. Fowler; E. A. A. Grange; C. H. Higgins; J. B. Hollingsworth; F. Torrance.

Quebec—A. A. Etienne.

VISITORS

Alabama—H. C. Ayer; D. E. Sawyer; H. P. Sims.

Colorado—G. H. Oliver.

District of Columbia—G. A. Prevost.

Illinois—M. H. Bohreen; I. C. Brenner; F. H. Burt; W. F. Christiansen; J. P. Dunn; M. E. Gavin; A. Eger; J. J. Ferguson; G. G. Florine; R. P. Frans; E. G. McCoy; Elinor McGrath; L. R. McKinley; J. W. Ranson; J. C. Rasmussen; C. P. Shaughenessy; H. C. Schults; D. E. Sisk; P. O. Summers; J. P. Thiry; C. F. Vincent; W. H. Welch; O. F. West; C. A. White.

Indiana—O. H. Brubaker; H. E. Bryan; O. A. Carson; W. E. Carter; O. E. Crossey; J. B. Current; A. J. Devenish; E. Ferree; C. E. Haflich; T. M. Hall; F. V. Hawkins; S. C. Irwin; G. C. Juday; C. P. Kime; F. E. Kling; W. H. Lane; L. Levens; M. H. Lidibey; J. S. McLaughlin; C. T. Meyer; G. W. Musselman; O. E. Ragsdale; V. O. Redick; J. T. Redman; H. S. Sailors; C. E. Sharp; F. W. Silberg; H. Stoffs; E. C. Test; C. C. Winegardner.

Iowa—J. S. Barber; W. I. Calkins; C. H. Hays; T. B. Huff; C. E. Juhl; N. A. Kippen; H. A. McIntire; J. G. Schoenenberger; J. H. Spence; R. D. Wall.

Kansas—W. A. Hagan.

Kentucky—H. L. Blackburn; R. L. Pontius.

Louisiana—E. I. Smith.

Maine—W. H. Lynch.

Maryland—G. H. Grapp.

Massachusetts—J. A. Viles.

Michigan—J. L. Ackerson; F. P. Allen; A. H. Motley; C. N. Anderson; H. M. Armour; R. Armstrong; H. L. Attridge; E. Austin; L. F. Baldock; A. F. Bartlett; J. D. Bell; S. H. Buck; J. C. Buckley; C. M. Carl; W. M. Chase; C. H. Clark; W. H. Clark; H. H. Clement; J. A. Clements; H. Cornehl; A. T. Cowell; F. F. Consaul; G. B. Cash; F. E. Coswell; D. D. Cranston; E. I. Crawford; A. C. Curtis; F. H. Davidson; O. G. Davidson; L. Davisson; R. H. Drake; C. B. Dunphy; H. Dunphy; W. H. Erwin; J. Euth; W. H. Ferguson; G. Fitchett; M. C. Fitznate; W. E. Gates; M. J. Gerger; G. H. Gorden; C. H. Greenfield; D. M. Hoge; H. H. Halladay; R. S. Hamilton; P. Harrison; W. R. Harper; W. A. Haynes; J. Hooker; W. J. Howden; I. F. Huddleston; M. P. Hunt; B. S. Hyman; B. Japink; F. S. Kedzie; D. T. Kemp; W. Kensler; Wm. Kindig; T. H. Kingston; E. L. Krieger; T. B. Ludington; T. S. McConnell; A. A. McDowell; A. I. McIntyre; G. D. McIntyre; H. H. McIntyre; R. S. Marshall; W. B. Massie; A. W. Mebert; G. C. Moody; C. E. Morford; A. W. Moore; H. M. Newton; H. W. Nobles; T. Olinger; Jas. Patterson; L. V. Patterson; B. A. Perry; H. E. Rea; O. Rice; H. F. Roberts; Schubel; G. H. Scoville; L. E. Starr; J. B. Stevens; H. E. Stiles; G. R. Switzer; B. N. Thomas; L. Thorburn; W. W. Thorburn; G. M. Thorndike; A. L. Tiffany; C. E. Turnbull; R. J. Vedder; E. J. Walter; W. D. West; L. A. Wileden; W. H. Wilkinson; C. F. Wilson.

Minnesota—B. L. Cook; L. C. Huff.

Missouri—G. G. Clark; J. B. Gingery; L. R. Harkins; C. F. Hatfield; C. V. Hover; J. H. McLevy; A. E. Morrow; C. W. Scott; J. J. Stephens.

Nebraska—G. B. Russell.

New Jersey—G. F. Harker.

New York—F. E. Cleaver; H. W. Hawley; J. F. Kane; G. C. Kesler; W. W. Otto; E. J. Soratkin; W. C. Smead; J. A. Wende; W. W. Williams; F. E. Wilson; V. H. Zahn.

Ohio—W. G. Adams; H. N. Beeman; M. Borsos; F. Brickley; A. Broerman; H. D. Campbell; E. H. Callander; J. B. Considine; W. L. Cook; S. R. Craven; G. R. Daunley; E. M. DeTroy; F. H. Detmar; N. Dock; W. A. Fany; P. H. Fulstow; R. H. Gittins; R. A. Greenwood; A. C. Hart; R. D. Heller; T. B. Hinkle; S R. Howard; C. E. Hanawalt; C. E. Inskeef; E. H. Jewett; C. A. Johns; M. J. Jones; T. L. Kelly; N. W. Kreuder; T. F. Kimball; G. H. Lasher; R. R. Laughlin; W. O. Longfellow; D. M. McCully; F. C. Meckstroth; A. E. Metzger; H. W. Miller; O. F. Nugent; C. B. Perkins; D. R. Powell; J. W. Reeder; G. L. Schneider; F. W. Seebert; A. Slough; J. H. Snook; H. H. Sparhawk; C. D. Turney; F. M. Vosburgh; C. C. Wadsworth; R. D. Way.

Oklahoma—W. P. Shuler.

Pennsylvania—E. E. Bittles; C. W. Brown; J. C. Elviage; J. O. Eyman; H. Hauptfuhrer, Jr.; A. McCloskey; L. J. McCloskey; T. F. Nugent; H. F. Pegan; W. Rubenwald; R. Reynolds; J. P. Schmidt; A. C. Wight; H. K. Wright.

South Carolina—W. F. Burleigh.
Tennessee—W. M. Bell.
Texas—P. P. Starr.
Vermont—J. Thomas.
West Virginia—J. Challander; E. Jones.
Wisconsin—L. H. Allen; H. A. Arpke; W. W. Arzberger; G. B. Bleecker; E. C. Humke; E. J. Pease; L. C. Taube.
CANADA. *Manitoba*—A. T. Folger.
Ontario—T. S. Biggar; H. Boyd; L. A. Brown; J. C. Buchanan; C. Elliott; L. H. Eckert; C. J. Johannes; B. D. Kennedy; C. N. Kramer; G. A. McLevey; J. A. McNish; G. W. Orchard; J. N. Pringle; W. W. Stevens; W. Sweet; A. M. Wilson.

NOTE:—A separate list of the ladies was incomplete. According to our count, there were 321 ladies in attendance.

SECRETARY'S OFFICE, A.V.M.A.

The following presidential appointments have been made during the month of October:—

Executive Board—(To serve until their successors have been elected). F. Torrance, 1st District; Jos. Hughes, 2nd District; J. R. Mohler, 3rd District; H. E. Bemis, 4th District; R. A. Archibald, 5th District; V. A. Moore, member-at-large. Acceptance lacking from Dr. Hughes.

Committee on Intelligence and Education—(Chairman to be elected by the committee.) S. H. Ward, Louis A. Klein, George H. Hart, R. C. Moore, and N. S. Mayo. The members of this committee are appointed to serve from five years to one year in the order named.

Committee on Legislation—(Chairman to be elected by the Committee. W. Horace Hoskins, J. P. Turner, S. J. Walkley, M. Jacob, A. T. Kinsley. The members of this committee, like the preceding, are appointed to serve for five years to one year in the order named.

Committee on Resolutions—John Reichel, Chairman, Adolph Eichhorn, Charles G. Lamb, W. G. Hollingworth, C. H. Stange. To serve for one year.

Audit Committee—A. S. Cooley, Chairman, George B. McKillip, H. Jensen, W. H. Robinson, Edward M. Ranck. To serve for one year.

Necrology Committee—Edward A Cahill, H. Fulstow, H. R. Ryder, C. C. Mix, C. D. McGilvray. To serve for one year.

Section on Sanitary Science and Police—(To serve until their successors are elected at the next annual meeting). J. G. Wills, Chairman, T. Edward Munce, Secretary.

Section on General Practice—Thos. H. Ferguson, Chairman, J. H. Blattenberg, Secretary.

Budget Committee—(Ex-officio membership). Charles E. Cotton, L. A. Merillat, F. H. Schneider, and the Chairman of the Executive Board. The Chairman of the Executive Board will be elected by the Board at its meeting in December at Chicago.

The greatest number of complaints about not receiving the *Journal* and other mail sent to them, comes from veterinary inspectors of the Bureau of Animal Industry, and the cause is usually traced to changes of address not reported to the Secretary's or Journal office. If members who move, even temporarily, will advise us promptly as to their where-abouts, the complaints will become exceptional.

Registrations due to the increase of annual dues from three dollars to five dollars are surprisingly few.

The cost of the postal-ballot for the election of the members of the Executive Board will be about thirty cents per member. A saving of fifty-one dollars, however, was made by enclosing the bill for dues with the ballot.

When the present administration took over the affairs of the association there were outstanding bills amounting to more than $2500.00 to meet on demand. This fact shows plainly that the perfunctory audit of the association's affairs that does not include a careful inquiry into the liabilities is worthless and dangerously deceptive.

The ballots for the nomination of candidates for the offices of District Member of the Executive Board, created by the new constitution, are dropping into the office in large numbers. The large number of scattering votes shows the need of concerted action on the part of the membership. Municipal, state and other local associations should take a hand in this election by recommending a candidate to their members.

In order to save a great amount of useless correspondence, it seems necessary to announce that the secretary is but the clerk of this election and cannot act as adviser to the members as to the qualification of candidates.

The voting for the nomination will close on November 27th, instead of November 20th, as stated on the ballots. This change is due to an unavoidable delay in mailing the ballots after the latter date had been printed upon them.

L. A. MERILLAT, Secretary.

MEMBERSHIP DATA

(Revised to September, 1916)

1.	Members who have paid dues of 1915 or 1916.....	1716
2.	New members, 1916.....	450
	Total members in good standing.....	2166
3.	Honor Roll including 1916.....	59
4.	Members who have paid dues for 1914.....	60
5.	Delinquents who should be suspended.....	134
	Total	2419
6.	Members whose names are in 1916 Directory but not found listed in Card Index Ledger.....	19
	Grand total	2438

L. A. MERILLAT, Secretary.

NEW YORK CITY VETERINARY MEDICAL ASSOCIATION

May, 1916.

The regular monthly meeting of this association was called to order by the President, Dr. Goubeaud, at 8:45 p. m.

The reading of the minutes, owing to the lengthy program, was suspended.

Dr. Cassius Way then read a very instructive and interesting paper entitled "The Production and Handling of Clean Milk."

Dr. Way's address was illustrated by moving pictures which vividly portrayed the modern way of producing and handling milk through all the different stages from the cow to the consumer.

Dr. Way said in part that the milk question had been greatly agitated in the last few years.

It constitutes 16% of the daily diet. It is a food product which spoils quickly and is a very important one on account of its price. One quart of milk has a food value equivalent to ¾ lb. of sirloin steak, 2 lbs. of chicken, eight eggs, one pound of halibut, or one pint of oysters.

Dirty milk is due to negligence, as dirty cows and improper handling.

The veterinarian is best qualified for dairy inspection and many of the largest and best equipped milk corporations employ a competent corps of veterinarians. These men are valuable not only for their knowledge of proper sanitary conditions, but also in the

control and eradication of bovine tuberculosis, various acute infections of the udder, diseases of the genito-urinary tract, such as metritis and contagious abortion.

Transmissible diseases such as scarlet fever, diphtheria, septic sore throat, typhoid and tuberculosis in children, may be carried through milk.

H. E. Cook, Dean of the St. Lawrence School of Agriculture, Canton, N. Y., was then introduced and gave a very interesting address on "The Veterinarian, the Clean Milk Producer."

Dean Cook said that he had been interested in the production of milk all his life and the milk business as a whole is one of the most complicated. Milk is the most important food product and still if, for any reason, a small advance in the price of the same is made or even suggested there is a general popular protest.

Not one quart in ten can have the whole cost of production charged against it or it would bankrupt the producer. Milk is generally the product of the work of the whole family.

Believes that the dealers are working on a small margin and the natural conclusion is that the consumer must pay more or new economies be discovered. Cheaper methods of distribution are possible but cheaper production would be difficult. Is trying to determine if the railroads are getting too much for transporting milk.

Dean Cook went into this matter very thoroughly. (His address was published in the *Journal* of the A.V.M.A., September 1916).

Dr. Harris Moak of the Brooklyn Certified Milk Commission, was then introduced.

The doctor said, in part, that in reviewing the milk situation in twenty cities he found the veterinarians doing excellent work in the production of clean milk and have taken a leading place in this important work.

Mentioned that in a great many stables dry methods are now being used in preference to scrubbing and flushing with water. Cornstalks and shavings are used for bedding and lime stone used to absorb moisture.

Condemned the common manger and watering trough as a means of spreading tuberculosis. Also discussed garget at some length and recommends dipping the teats in mild antiseptics after milking.

Dr. Jas. McDonough of Montclair, N. J. spoke of perfecting the system of delivering milk and explained the method employed in New Jersey.

Dr. W. H. Hoskins of Philadelphia was present and stated that he took a deep interest in the milk question.

He quoted the late Dr. Leonard Pearson as saying twenty years ago that the milk supply of Philadelphia, to obtain the best results, should be in the hands of a very few large companies and not handled by the many, and should be under municipal control.

Dr. H. D. Gill spoke in favor of subduing dust by moisture and stated that the bacterial count is lowered by plenty of washing. Also said that animals that fail to show post-mortem lesions, that have been reactors to the tuberculin test, does not prove that no disease exists. The proper and safe method to keep a herd free from tuberculosis is to maintain a breeding herd.

Purchasing animals to replenish a herd is the principal source of infection.

Dr. E. B. Ackerman spoke of moisture in stables and was of the opinion that heat and moisture would help to produce the tubercle bacilli. Indorsed the individual trough and pail.

Dr. J. F. DeVine, of Goshen, N. Y., also took part in the discussion.

Dr. J. G. Wills, Chief Veterinarian, Dept. of Agriculture, N. Y. State, referred to Dean Cook's allusion to the producer and the labor involved and said that if the dairy man sees a fair cash return for his labor and outlay it will stimulate him to produce a clean, wholesome milk.

Considers the common drinking trough a great source for distributing disease and cited a case of a virulent spreader in support of his statement.

Referring to the statement of Dr. Moak, that animals suffering from garget simulate a tuberculin reactor, he said that this simply emphasizes the necessity of making a careful physical examination. It is also important to give the complete data on the charts submitted to the authorities.

The Program Committee reported that they had decided to withdraw the motion to change the dates of the meetings. This report was duly accepted.

Dr. Griessman submitted a resolution on preparedness, which after some discussion was, on motion, laid on the table.

A letter from Dr. W. H. Kelly of Albany, relating to pending legislation, was read.

It was regularly moved, seconded and carried that a committee draft a letter to the Governor and Board of Regents opposing the passage of this bill.

Dr. Hoskins stated that it was a source of pleasure and satisfaction to him to be able to report that on the 17th day of April the Army Bill had become a certainty and the rank of Major recommended for the veterinarians in the army.

A hearty vote of thanks was extended to Dean Cook, Dr. Way and all others who took part in the program of the evening. Adjourned.

ROBT. S. MACKELLAR, Secretary.

BRITISH COLUMBIA VETERINARY ASSOCIATION

The annual general meeting of the British Columbia Veterinary Association was held at Vancouver, B. C. September 20, 1916.

The President, Dr. S. F. Tolmie, expressed his regret at not being able to be present, having to appear on that date before the Royal Commission on the Resources of Canada, but he forwarded his address which was read by the secretary.

In it he briefly reviewed the activities of the association for the past year, complimenting the secretary in his work, stating that action had been taken under our Act against members more than four years in arrears, and that 14 members were at the front, whose fees were remitted while away, and that a committee had been appointed to bring a recommendation before this meeting to amend the by-laws to admit honorary and associate members to the association.

The President also stated that five candidates had been admitted to membership during the past year, and that two very successful public meetings had been held in Vancouver and Victoria on matters relating to Public Health, the speakers at both meetings being veterinary surgeons, members of this association, mentioning Dr. Jervis for the active part he had taken, and expressing a wish that more would be held during the coming year. Also a number of stock owners had made application to the secretary that veterinary surgeons be sent to their districts, which requests had been complied with. The address concluded with the President's best wishes for the success of the association for the coming year.

After the reading of the address various matters were discussed by the members present and adjournment was taken for lunch at the Castle Hotel. On reassembling an interesting address was given by Dr. L. D. Swenerton of Vancouver describing the work in general of the Royal Army Veterinary Corps in England and France, and the various hospitals there, and his work in particular, having just returned from France on leave. Veterinary surgeons in the British Canadian Forces rank as Lieutenants and are promoted to Captains after one year's active service. Dr. Taylor of Ladners, B. C. read a newspaper clipping of a speech of Senator Cummings, given in the United States Senate in support of the bill to make veterinary surgeons rank as officers in the United States Army.

Dr. Bruce of Agassiz, B. C. then gave a very instructive address on "Poisonous Plants of British Columbia", illustrated by specimens prepared by himself.

Election of officers then took place, resulting as follows:—President, Dr. S. F. Tolmie; Vice-President, Dr. George Howell; Secretary-Treasurer, Dr. K. Chester; Council:—the above officers together with Drs. Alton, Pickering, Jagger, and Jervis.

A resolution was passed that as most of the annual meetings had been held at the coast it would be a good thing to hold the next annual meeting in the Upper Country and the secretary was instructed to write to the Upper Country members and ask them to get together and choose a suitable town convenient to all and the coast members will come up and attend.

The social committee was appointed by the Vice-President, In the absence of the President, as follows:—Drs. Jervis, Jagger and Swenerton.

This brought a very successful meeting to a close.

KENNETH CHESTER, Sec.-Treas.

MASSACHUSETTS VETERINARY ASSOCIATION

The October meeting of the Massachusetts Veterinary Association was held in Springfield on October 18. The meeting was held in conjunction with the National Dairy Show, and as was expected, the combination of the two proved a very great attraction.

After the arrival in Springfield, all journeyed toward the Eastern States Exhibition, where the National Dairy Show was being held. After registering at the temporary headquarters of the association, which were in the Coliseum, the members spent

the day according to their own inclinations, endeavoring to see some of the many attractions which were presented. All were agreed in declaring it the greatest event of its kind that they had ever seen, and we were forcefully impressed with the beauty and permanency of the buildings which had been erected to house this show. We were considerably interested after forming this opinion, to hear the opinion of some of the prominent western veterinarians who were in attendance, and who have always attended the show which heretofore had been held in Chicago. They seemed to be agreed that it was the greatest Dairy Show ever held in this country, and greatly surpassed the previous shows at Chicago. It was impossible to see more than a few of the many attractions of the different places as they were being exhibited. However, the time spent there was very profitable to all of us.

At seven o'clock, members and friends met at the Hotel Worthy, where an unusually good banquet was served. Following the banquet, a short business meeting was held, during which eighteen applications for membership were received. One hundred fifty-two members and guests partook of the banquet. After dinner, and before the speeches began, fully twenty more arrived who were unable to be present at the banquet.

Dr. James B. Paige of the Massachusetts Agricultural College acted as toastmaster. The first speaker of the evening was Dr. V. A. Moore, Dean, New York State Veterinary College, Cornell University. Dr. Moore's subject was "The Practical Application of the Tuberculin Test". It proved to be one of the best addresses to which the association has ever had the pleasure of listening. It was exceedingly practical, and at the same time included many scientific aspects of the disease. Many of the common errors which are made in applying the test were spoken of, and many mistaken ideas regarding the disease and its control were discussed in detail. It was indeed a scholarly presentation of the entire subject, and was listened to with rapt attention by all persons present.

Dr. W. Horace Hoskins, Philadelphia, Pa., was the next speaker, and forcefully addressed us on the subject of "Associations and Association Work". Dr. Hoskins was, as is always the case, very well received by the members, who thoroughly enjoyed his remarks. He impressed us with the advantages of associations and of some of the present aspects of the association work, to-

gether with a wonderfully brilliant review of the profession in this country.

Dr. Thomas Maloney of Fall River responded to the toast "The Ladies", in his usual skillful manner, and needless to say he made a wonderful impression, particularly on the ladies, in spite of the fact that he admitted several things which we have always suspected him of, but of which we were never certain.

The last speaker of the evening was Dr. E. C. Schroeder of the Bureau of Animal Industry, Washington, D. C. Dr. Schroeder's paper was on "Infectious Abortion", and proved to contain all that was new and interesting on this very important disease.

It is doubtful if any two subjects could have appealed to those present more than the ones presented by Dr. Moore and Dr. Schroeder. Dr. Schroeder most successfully extracted from the maze of misunderstanding and uncertainty which surrounds infectious abortion, the factors which are known to be of practical and certain application, so that we were able to discard much of the unimportant. His entire paper was masterful, and was greatly appreciated by all present.

Our chief regret was that the hour had become so late that we were unable to hear from the many noted veterinarians who were present. There were many present from other states whom we greatly respect and seldom see, and from whom a few remarks would have been greatly appreciated. A large number of veterinarians were present from New Hampshire, Connecticut, Rhode Island, New York, Vermont, and Maine.

EDWARD A. CAHILL, Secretary.

REVIEW

SHEEP DISEASES

E. T. BAKER, D.V.M.

Published by the American Journal of Veterinary Medicine, Chicago, Ill.

This book of 228 pages is published as No. 12 of the Veterinary Medicine Series, edited by D. M. Campbell. It contains the following sections or chapters: History of the Breeds; Anatomy; Hygiene; Medicines and their Administration; Acute Infectious Diseases; Diseases of the Blood; Diseases of Metabolism; Diseases of the Urinary Organs; Diseases of the Circulatory Organs;

Diseases of the Respiratory Organs; Diseases of the Digestive System; Diseases of the Liver; Diseases of the Peritoneum; Diseases of the Brain and Spinal Cord; Diseases of the Organs of Locomotion; Non-Parasitic Diseases of the Skin; Diseases of Obscure Origin; Diseases of the Lamb; Diseases of the Ewe; Diseases of Rams and Wethers; Surgical Diseases; Parasitic Diseases; Poisons; Predatory Animals; Quarantine and Transportation Regulations.

The above classification indicates the comprehensive list of subjects treated. In a book of this limited size, conciseness is a matter of necessity. Some of the chapters are only a page or two in length. So long as the essential facts are given, conciseness is a virtue which the busy practitioner readily appreciates.

Of particular importance are the internal diseases, parasites and, in some localities, poisoning by plants. These subjects are discussed more extensively. The author states that larkspur does not cause so much loss among sheep as among cattle, and among the symptoms notes a stiff and trembling gait with frothing at the mouth, and that the victim often dies before reaching the nearest watering place. A recent report by investigators from the U. S. Department of Agriculture states that sheep eat larkspur with impunity and recommend, as a protection to cattle, that sheep be allowed to graze over the infested area in order to clear it of the noxious substance before the cattle are allowed to feed there.

Although the book is written largely from the western viewpoint, where range grazing predominates, it is none the less useful for those in the east, where sheep raising has, for some time been a minor portion of the livestock problem. That this branch of the industry needs and will receive greater attention in the East, there can be little doubt. We can heartily endorse the author's statement in his prefatory note, that "As economical producers of those prime necessities of civilized man, good food and good clothing, sheep are destined to increase in numbers, and sheep raising will speedily attain and maintain a more important place in the animal industry of this country."

The book is printed upon high grade paper, contains excellent illustrations, including some colored plates of plants poisonous to stock, and is a credit to the publisher. P. A. F.

COMMUNICATIONS

DIOCTOPHYME, NOT DIOCTOTHYME

In the September number of the *Journal* of the American Veterinary Medical Association, I presented a summary of the available cases of the occurrence of the giant nematode, *Dioctophyme renale*, in the United States and Canada. In the interests of stability of nomenclature, I used the generic name *Dioctophyme*, proposed by Collet Meygret in 1802, instead of the widely used name, *Eustrongylus*. Unfortunately, the erroneous spelling of Dioctothyme slipped through proof and thus if uncorrected, I have added to, rather than lessened confusion of nomenclature.

WM. A. RILEY.

THE BALKAN RELIEF FUND

Editor "American Veterinary Review":
Dear Sir:

Starving Albania, without even a newspaper of its own to make public its need, is dying in silence, its tragedy passed by unheeded.

Will "The American Veterinary Review" open a door through which its appeal for help may reach the people of the United States?

A number of distinguished gentlemen in New York—mostly clergymen and editors of newspapers—will co-operate in an appeal for a relief cargo for the ship. The treasurer selected to receive contributions is the Rev. Frederick Lynch, D.D., Editor of the Christian Work and Secretary of the Carnegie Church Peace Union. Contributions in any amount—from the price of a loaf of bread upward—may be sent to the Balkan Relief Fund, 70 Fifth avenue, New York City.

Yours truly,
WM. WILLARD HOWARD, Secretary.

Dr. W. H. Meadors, veterinary inspector of the Bureau of Animal Industry, has been transferred from National Stock Yards, Illinois, where he has been stationed for a number of years.. He has been placed in charge of the meat inspection work of the Bureau at Birmingham, Alabama.

Dr. Russell A. Stephens, veterinary inspector on the Bureau of Animal Industry force at Cincinnati, Ohio, has been transferred to Calexico, California, where he has been detailed to inspect meats for the United States Army.

Dr. H. G Hodges has removed from Sidney Center to Worcester, N. Y.

The marriage of Miss Catherine D. Seamon and Dr. D. B. H. Dalrymple occurred at Ithaca, N. Y. October 2. They will take up their residence at Otselic, N. Y., where Dr. Dalrymple will practice.